

AN APPRAISAL OF MORTALITY DATA FROM
THE NATIONS OF SOUTH AMERICA

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to

Marie and Les Lee,

My Family

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CHAPTER I

INTRODUCTION

This study is an appraisal of the mortality data presently available from the nations of South America. Absolute accuracy in mortality statistics is not now attained by any nation in the world, and it probably is not even a realistic goal. However, when there is awareness of the specific limitations of the materials from South America and procedures developed to overcome these deficiencies, then analyses of the data can lead to advances in our knowledge of mortality in this part of the world.

Objectives of This Study

During another study exploring the relationship between certain causes of death and the associated social structure and processes, it became desirable to use the mortality statistics of the nations of Latin America for comparative purposes. Serious doubts about the advisability

of these comparisons arose when recourse to the United Nations Demographic Yearbook for 1957 showed that of the nineteen republics, which evolved from the Spanish and Portuguese colonies, only six considered their statistics reasonably complete, with thirteen countries evaluating their data as unsatisfactory, incomplete, or of unknown quality.¹ There were doubts and questions about the adequacy of the mortality statistics even for the six countries that considered their data to be complete.

After a preliminary search of the literature failed to disclose any substantial assessments of the quality of the mortality data for these countries, letters of inquiry were directed to the various national offices and to the international agencies concerned with mortality statistics. The refrain of the replies that were received indicated that very little had been done in appraising the data, but that

¹United Nations, Demographic Yearbook, 1957 (New York: United Nations Statistical Office, 1957). Only Argentina, Chile, Guatemala, Mexico, Uruguay, and Venezuela considered their mortality statistics as reasonably complete. Bolivia, Colombia, Ecuador, Honduras, Nicaragua, Panama, Paraguay, and Peru evaluated their mortality statistics as incomplete or unsatisfactory. Brazil, presenting data for only the Federal District and the state capitals, made no attempt to assess the quality of the statistics.

they would consider such a study to be valuable and would be interested in the results.

A complete appraisal of mortality data would involve such facets as an evaluation of the completeness of death registration; the accuracy of information on age, sex, race, residence, etc.; the diagnostic and certification practices employed in determining the cause of death; the completeness and accuracy of the coding and tabulation of the information available about the death and the decedent; the accuracy and rapidity of the transfer of the original registrations into useful statistical tabulations; and the availability of the statistics and their qualifications. Even to the extent that such an appraisal would be within the capability and resources of an individual investigator, such an undertaking would involve many years of labor before substantial, tangible results could be reported.

Obviously one demographer with rather limited resources could not expect to produce a definitive evaluation of the available mortality statistics when the respective national governments and the interested international agencies consider such an undertaking to be beyond their own relatively great resources. However, for those who must depend on their own resources, to abandon any attempt to

evaluate the data would result in succumbing to the vicious circle that often develops in the production and analysis of demographic statistics: the official agencies do not attempt an undertaking because there is not sufficient interest and demand; and the individual investigator hesitates to develop an interest in an area which will produce minimal investigative returns due to the lack of sufficient official, authoritative data.

Since the broad, overriding objective of this investigation is to discover how to make immediate maximal use of the presently available mortality statistics, it was decided to confine the first phase of the investigation -- the study reported here -- to a brief exploration of mortality registration and reporting system practices, to a preliminary exploration of reported causes of death, and to an evaluation of the accuracy of the reported and estimated levels of mortality in the ten nations of Hispanic origin in South America. It was felt that this information would provide a sound base for the later expansion of the appraisal to other facets of mortality data and to the other nine nations of Latin America. In addition, this study should provide information of immediate value to others engaged in the interpretation of the available statistics.

The Scope of the Investigation

Although it is recognized that the mortality data from the countries of South America share many similarities with those of the other nations of Latin America, this investigation is limited to the ten Hispanic republics of South America. This geographic limitation was the result of one part of the methodology employed in this study. Personal observations of the procedures of the statistical agencies in each country, and conversations with the persons engaged in these procedures, were necessary in order to evaluate properly the data that were produced. The available resources restricted the geographic area that could be included in this study.

The decision to consider primarily the data for the years 1954 through 1964 was the result of three considerations. First, this is the most recent period for which mortality statistics are available. Second, the data available for these years are reasonably consistent, since there were no changes in international statistical recommendations and a minimum of changes in international classification procedures during this interval. And third, this is a period of increased emphasis on the importance of mortality statistics in these countries.

The consideration given to mortality registration systems, rather than confining the study to the data that are produced, represents an expansion of the appraisal that may be considered unusual. However, this was considered to be an essential part of this study. The inaccuracies that exist in mortality statistics are the result of deficiencies in the registration systems. Until the problems of a mortality registration system are understood, there is great difficulty in assessing the usefulness of the data that are available.

The Significance of This Investigation

Appraisals of the available mortality data are essential in order to interpret with confidence the results of analyses of the statistics. Thus, this study is a first step in obtaining reliable information about mortality in this part of the world.

The significance of this first step can be appreciated when it is realized that, despite the importance of knowledge about the mortality experience of the nations of South America, the situation at present is little different than more than ten years ago when Stolnitz noted that the

material " . . . for Latin America is more nearly characterized as scattered than substantial. The best documented sections are the small populations of the Caribbean and the available information is probably a good deal short of reliable even here."¹ The basic change during this period has been mostly in the availability of the statistics which are now presented in the publications of several international agencies.²

Although these published statistics are often quoted in the literature, the lack of comprehensive analyses of the data on mortality for this area of the world is not surprising when the nature of the available material is considered. Even heroic efforts by the most capable students of population would probably have produced only extremely modest results.³ There is little doubt that such strenuous

¹George F. Stolnitz, "A Century of International Mortality Trends: I," Population Studies, Vol. IX (1955/56), pp. 24-55.

²See various issues of the United Nations, Demographic Yearbook; World Health Organization, World Health Statistics Annual (formerly Annual Epidemiological and Vital Statistics); and Inter American Statistical Institute, America en Cifras.

³For example, even Smith, who probably produced more extensive and intensive analyses of the various demographic statistics from South America than any other individual, has been forced to pay minimal attention to the limited mortality

efforts would do little to answer the fundamental questions involved in the study of mortality: a determination of accurate rates of mortality; an examination of their variation from group to group, place to place, and time to time; and, most important, an analysis of the factors responsible for this variation.

While the situation with respect to the development and analyses of these statistics from the nations of South America has remained relatively static, the necessity of obtaining and utilizing the knowledge gained from this information has increased greatly. No longer are the data needed solely for comparatively small, isolated projects and programs, but now these materials constitute a vital part of the planning for development, both economic and social, which will permanently influence the future of these nations and this part of the world.

The Importance to Public Health

The increasing recognition of the critical importance of reliable mortality statistics may be found in the constant refrain that runs through the report of the Task Force on Health at the Ministerial Level.

data which are available. See T. Lynn Smith, Latin American Population Studies. University of Florida Monographs, Social Sciences, No. 8 (Gainesville, Fla.: University of Florida Press, 1960).

The starting point for the establishment of priorities is an accurate knowledge of the [health] problems. That calls for epidemiological investigation and reliable statistical data, a field to which urgent attention must be given in Latin America. Vital and health statistics are still incomplete. Yet such data are essential for formulating sound programs, establishing targets, and evaluating results.¹

This statement represents the strongest recognition at the highest governmental levels that may be found to date. It is a decided departure from the mild, although important, recommendations which are found emanating from previous meetings concerned with mortality statistics.²

The Importance to Demography and Sociology

The health fields are not the only users of mortality data. These statistics are absolutely essential to the demographer, since they are the materials on which he bases his study of one of the three primary factors -- births, deaths, and migration -- which account for the changes in

¹Pan American Health Organization, Task Force on Health at the Ministerial Level, Washington, D.C. 15-20 April 1963. Official Document No. 51 (Washington, D.C.: Pan American Health Organization, 1964), p. 7 and passim.

²For example, see Pan American Union, Tercera Conferencia Interamericana de Estadística, Petrópolis, Brazil, 9 al 23 de junio de 1955, Acta Final (Washington, D.C.: Pan American Union, 1956), pp. 89-97.

any given population. Although concern about the rate of population growth in developing countries has tended to focus attention upon fertility, the present high rate of population growth apparently is the result of changes in mortality experience rather than changes in the fertility of populations.¹

Without entering into the debate about whether or not demography is a sub-field of sociology, it may be stated that the sociologist also is interested in demographic variables and processes in the analysis of the social characteristics of populations. Because they provide relatively easy availability of data when compared to other statistics -- as is true of all types of official demographic data -- they are utilized in the analyses of social structures and processes. Rates of family formation and dissolution are influenced by sex differentials in mortality. Socio-economic differentials in mortality, as well as in fertility, may play an important part in social mobility, which is the upward or downward movement in the social hierarchy. Optimism or pessimism which give rise to

¹T. Lynn Smith, "The Reproduction Rate in Latin America," Population Studies, Vol. 12 (1958/59), pp. 4-17. See also T. Lynn Smith, "Current Population Trends in Latin America," American Journal of Sociology, Vol. 62 (1956/57), pp. 399-406.

particular types of social action may have part of their determinants in the patterns of mortality found within a society.

The illustrative examples just mentioned may be considered as the social consequences of mortality patterns, and, unfortunately, are just now starting to become the subject of concentrated scientific investigation, although they have long been the subject of speculation. The opposite approach, the investigation of the influence of social factors upon mortality patterns, has been receiving considerable attention for many years from those areas of sociology which are tangential to public health.¹ In at least one case, infant mortality, the relationship between these deaths and socio-economic conditions has been so close and constant that the infant mortality rate has been used as a measure of the social welfare and health status of a population rather than as a dependent variable in sociological analysis.²

¹A brief survey of the more recent literature may be found in the chapter by Saxon Graham, "Sociological Aspects of Health and Illness," in Robert E. L. Faris (ed.), Handbook of Modern Sociology (Chicago: Rand McNally & Company, 1964), pp. 310-347.

²George C. Whipple, Vital Statistics (New York: John Wiley & Sons, Inc., 1923), p. 393. See also S. Chandrasekhar,

The preceding discussion cannot attempt to delineate all of the possible uses of mortality statistics in demographic and sociological analyses. It will have to suffice to state that the potential manifold uses will be dependent upon the availability of mortality data and knowledge of their accuracy.

The Methodology of This Study

At the outset of this study it was realized that the choice of the methods of investigation to be employed in this evaluation would be a factor of prime importance. Many techniques have been enumerated by the Statistical Office of the United Nations for the appraisal of vital statistics systems and the data produced by them.¹ These

Infant Mortality in India, 1901-55 (London: George Allen and Unwin, Ltd., 1959), passim; and W. P. D. Logan, "The Measurement of Infant Mortality," Population Bulletin of the United Nations, No. 3 (1953), pp. 30-55.

¹United Nations, Handbook of Vital Statistics Methods. Series F, No. 7. (New York: United Nations Statistical Office, 1955) pp.200-212. See also United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961), pp. 1-10; and United Nations, Department of Economic and Social Affairs, Methods of Appraisal of Quality of Basic Data for Population Estimates. Population Studies No. 23 (New York: United Nations, 1955), pp. 18-30, 53.

range from direct methods, such as corroboration by the surveys and matching with cemetery lists and notification registers, to indirect methods, such as balancing equations and comparisons of the consistency of age-sex patterns in mortality.

However, if this study was to avoid the pitfalls faced by the few other explorations which have also sought to evaluate the statistics, a new approach was needed. The direct methods required too great an expenditure of funds and time to be feasible for an individual investigator; the usual indirect methods of comparison with balancing equations and values derived from theoretical life tables, while possessing the advantage of mathematical rigor, still remain to be confirmed by basic observations.

The Comparative Techniques

The approach which was felt to be most capable of meeting the needs of this evaluation is that of building upon the present state of our knowledge about mortality registration systems and mortality statistics. There is general agreement about the conditions necessary for a good mortality registration system. The question then becomes: How closely do the conditions of the registration systems

of the ten South American nations approximate those which are known to be of good quality? Similarly, the factors associated with various levels of mortality are generally agreed upon. The question posed is: To what extent are these factors present in these countries?

The literature was searched to discover the background factors which helped and hindered in the establishment of vital registration systems known to be of good quality. These were compared to the descriptions of the South American registration systems. Although it was possible to discover the factors that contributed to good mortality registration, it was not possible to find in the scanty literature whether these factors existed in the countries of South America.

Similarly, comparisons were made between levels of mortality and causes of death in the nations of South America and those in other parts of the world known to have mortality statistics of good quality. Again questions arose which could only be answered by personal observation.

The Field Work

Approximately six months of field work were devoted to a series of observations seeking to explore the possible

answers to the questions that had been raised. During this time the author personally visited each of the countries except Venezuela.¹ Through the cooperation of each of the zone offices of the Pan American Sanitary Bureau, it was possible to gain rapid and complete access to the official and semiofficial organizations comprising the mortality registration systems of the respective countries. The numerous individuals who were consulted, having great interest in the aims of the study, were most free in offering their personal evaluations of the strengths and weaknesses of their registration systems. Their observations and evaluations were constantly checked against each other and those of the author.

In part, the success with which the field work met was due to the choice of Santiago, Chile, as the starting point of this phase of the study. This city, which was the location for the Centro Interamericano de Bioestadística and is the present location of the Centro Latinoamericano de Demografía, as well as other international activities

¹It was originally intended that Venezuela be visited also, but at the last moment this country had to be omitted from the itinerary. Extensive correspondence and the background gained from visiting the other nations have partially alleviated this deficiency.

with an interest in the study of Latin American populations, has become the unofficial focal point for information about demographic activities in South America. Informal discussions with the staffs of these institutions and the visitors from the nations of South America provided valuable clues for further observation and many personal introductions to persons who should be contacted during the field work.

Although this field work took place during the latter part of 1961 and the early part of 1962, much of the statistical work underway at that time has only recently become available. Also, personal communication with many of the individuals involved in the collection and analysis of mortality data in these nations has provided reassurance that very few basic changes have taken place since then. Thus, despite the delay in making these observations available, they are as applicable today as when they were originally made.

Sources of the Data

Except for the personal observations made during the period of field work, which are qualitative in nature, the sources of data used in this study are rather widely available. These include the statistical publications of

the various international organizations and the statistical yearbooks of the several countries. Citations to these are given in the appropriate places, as are the citations to other sources of information.

The essential qualifications of the statistics which provide the basis of the computations are noted. However, the reader is urged to refer to the original sources for the full qualifications.

The category numbers of causes of death are from the "Abbreviated List of 50 Causes for Tabulation of Mortality."¹ The reader should refer to this in order to appreciate the specific diseases that are included in each category.

Measures and Indexes

Conventional measures and indexes are used throughout this investigation. Differences between percentages are the basic statistical tool utilized.

¹World Health Organization, Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, 1955 Revision. Vol. 1 (Geneva: World Health Organization, 1957), pp. 381-382.

The Order of Presentation

The "Brief Review of the Literature" has as its purpose acquainting the reader with the most pertinent analyses of mortality in the nations of South America and the more important sources of mortality statistics. A few studies not specifically directed toward South America are noted when the points that they make are directly applicable to these countries. The review is selective rather than inclusive.

The chapter "Death Registration in South America" is an evaluation of the strengths and weaknesses of the mortality registration systems in these countries. The development of death registration systems in other parts of the world is also noted in order to provide the proper perspective for evaluation.

"The Accuracy of Cause-of-Death Statistics" examines the quality of the certification and coding procedures; while the next chapter, "Important Causes of Death," presents suggested broad categories found useful in analyzing mortality statistics from these countries.

The analysis of "Rural-Urban Differentials in Cause of Death" is included, since residence may be a factor

influencing the levels of mortality found in these nations.

Finally, the chapter, "Levels of Mortality," is a comparison of the findings of the previous chapters with the conditions and levels known to exist in other countries of the world. Estimates of the expected levels of mortality based on these comparisons are presented.

CHAPTER II

REVIEW OF THE LITERATURE

If serious study of fertility in Latin America is considered in its beginning stages, then similar studies of mortality in South America must be characterized as being mostly in the process of conception.¹ Even though the literature pertaining to these countries is replete with references to mortality statistics, little attention has been given to the quality of the data and to the thoughtful analysis of the statistics.

This brief review of the literature can do no more than acknowledge studies that are considered to be representative of their times, to give note to those which are considered to be of particular significance, and to show the problems involved in the serious analysis of the mortality data from the nations of South America. Most of the

¹T. Lynn Smith, Latin American Population Studies. University of Florida Monographs, Social Sciences, No. 8 (Gainesville, Fla.: University of Florida Press, 1960), p. 35.

sources that are cited contain references that can be useful to those persons wishing to probe more deeply into this subject.

The Early Period

The early period, which is considered to be prior to the early 1940's, is characterized by the sparseness of the mortality statistics that were available for analysis. The works of travelers and other observers of the social scene in some of the nations of South America might contain comments on the current situation with respect to disease and death. However, data that could be used for serious analyses were generally lacking.

A notable exception to this lack of statistical materials and their analyses is the compilation of mortality data for the Western Hemisphere by Hoffman.¹ Since the statistics presented were gathered from official publications and other official sources for life insurance purposes, Hoffman did not provide any actual analysis of the data.

¹Frederick L. Hoffman, Mortality of the Western Hemisphere. Panama-Pacific Exposition Memorial Publications of the Prudential Insurance Company of America, No. 3 (Newark, N.J.: Prudential Press, 1915).

However, the tables were constructed so that interpretation could be made readily of trends between 1890 and 1914 in the levels of mortality and important causes of death. The possible deficiencies of the data were noted and the need for caution stressed, since these materials were of varying quality. Included in the information to be gathered from this work is the fact that a crude death rate in excess of 40 per 1,000 population was sometimes seen in the period 1890-1910. Also of interest is that the mortality rates of the large cities tended to be greater than those for the rest of the country.

The publication of the Statistical Activities of the American Nations: 1940 was of great importance to the study of mortality in South America.¹ This was a comprehensive survey of the data gathering and tabulating procedures in each of these countries. The descriptions provided valuable clues to the quality of the statistics that were

¹Inter American Statistical Institute, Statistical Activities of the American Nations: 1940 (Washington, D.C.: Inter American Statistical Institute, 1941). The second edition of this work is being published in the form of separate pamphlets each devoted to a single country. Publication of the series started in 1956.

available. Even though this does not contain any analyses of the statistics, the background information that is presented aids in the interpretation of official data found in other volumes.

A related effort to increase knowledge about the availability of demographic statistics from the nations of South America resulted in a relatively complete listing of all of the publications containing demographic data issued by these countries.¹ Many ephemeral and short-lived publications, which were generally unknown outside of the respective countries, were included. Information about unpublished data was also included.

Linder's work on the Caribbean area was an effort to assemble and make available the pertinent statistics for this area.² A similar attempt for the countries of South America was made by Dunn, Eldridge, and Powell.³ The series

¹U.S. Bureau of the Census, General Censuses and Vital Statistics in the Americas. Prepared under the supervision of Irene B. Taeuber (Washington, D.C.: Government Printing Office, 1943).

²Forrest E. Linder, "Population and Population Statistics of the Caribbean Area," Vital Statistics -- Special Reports, Vol. 12 (1941), pp. 559-571.

³Halbert L. Dunn, Hope Tisdale Eldridge, and Nora P. Powell, "Demographic Status of South America," Vital Statistics -- Special Reports, Vol. 23 (1944), pp. 63-78.

of reports prepared by the United States Bureau of the Census in cooperation with the Office of Coordinator of Inter-American Affairs represented similar, although more comprehensive, compilations of the vital statistics of these countries.¹ All of these publications have as their purpose the presentation of statistics that were normally unavailable, and all are characterized by having little or no analysis of the materials that were presented. Repeated cautions about the possible poor quality of the data run throughout all of these.

The Middle Period

The years between the mid-1940's and approximately 1960 may be typified as the middle period in the analysis and appraisal of mortality statistics. In contrast to the early period, data were relatively plentiful. The presence of these materials, joined with the interest that had been aroused by the early compilations of statistics, resulted in the start of actual analyses of mortality levels, differentials, and trends.

¹See Argentina: Summary of Biostatistics (Washington, D.C., processed, 1945); and comparable volumes for the other countries issued at about the same time.

The publication of the Summary of International Vital Statistics: 1937-1944 may be considered as the link between the early and the middle periods.¹ Even though the major purpose was to provide a readily available compilation of international vital statistics, an analysis that was substantial in breadth, if not in depth, was included. The international scope of this project prevented any detailed attention to the data from the nations of South America. The extensive notations of the qualifications of the statistics promoted a higher level of confidence in analyzing these materials.²

The year 1948 is very significant in the general availability of mortality statistics. The United Nations began publishing its Demographic Yearbook and the World Health Organization started its Annual Epidemiological and Vital Statistics. The statistics are compiled from the various national sources and suffer from a lack of complete

¹U.S. National Office of Vital Statistics, Summary of International Vital Statistics: 1937-1944 (Washington, D.C.: Government Printing Office, 1947).

²It is interesting to compare the similarities between this volume and the then soon to be started annual Demographic Yearbook of the United Nations. The similarities are not surprising, since many of the persons who were directly or indirectly responsible for the former publication also were responsible for the latter.

uniformity in quality and quantity. However, extensive notations on the qualifications of the data are useful in the analyses of the materials.

Two distinct types of analyses of mortality in South America were developed during this period. The first, in the tradition of John Graunt, made use of the available data despite their obvious limitations. Skillful analysis and a high degree of caution in interpretation were used to glean a maximum amount of information from limited data. Previously undiscovered inconsistencies and defects in the data were discovered through these skillful techniques. The second type of analysis considers the defects of the available data to be too great. Data derived from model life tables that closely conform to stated expectations provide the materials to be analyzed. The elaborate procedures possess great mathematical rigor.

The analysis of Brazilian mortality by Smith is one of the comparatively rare examples of the first type of analyses.¹ Skillful investigation established that the crude death rate was at least 20 per 1,000 population for

¹T. Lynn Smith, Brazil: People and Institutions (Baton Rouge, La.: Louisiana State University Press, 1946), pp. 242-263.

almost all parts of the country. He was also able to substantiate the hypothesis that the darker the color the skin of the population, the higher was the mortality level. Since there is an inverse relation between darkness of the skin (the racial factor) and socio-economic status in Brazil, this was the equivalent of " . . . saying that there was a negative relationship between social and economic status and the death rate."¹

A similar, although not as extensive, analysis of mortality in Ecuador was carried out by Saunders.² The minimum crude death rate for the country was established to be in excess of 22.2 per 1,000 population in 1955. Also, preventable deaths from whooping cough, bronchitis, and measles, although contributing greatly to the mortality of the country, are less likely to be registered since they " . . . more often affect in a fatal way persons in the lower socioeconomic strata than in the upper, and the deaths of those, in turn, are less likely to be registered

¹Ibid., p. 249.

²J. V. D. Saunders, The People of Ecuador: A Demographic Analysis. Latin American Monographs No. 14 (Gainesville, Fla.: University of Florida Press, 1961), pp. 55-61.

than those of members of the upper class. . . ."¹

Mortality in Brazil has received concentrated attention from Mortara. His analyses of mortality have ranged from the construction of life tables based on census statistics to the determination of infant mortality tables.²

The other type of analysis, using model life tables and other hypothetical concepts, is much more likely to be encountered. All of these studies share the common characteristic that they are willing to make inferences and assumptions that still remain to be tested by the other type of analysis.³ The reader will have no trouble finding examples of the utilization of model life tables in the analysis of mortality in South America.

¹Ibid., p. 60.

²United Nations, Department of Social Affairs, Methods of Using Census Statistics for the Calculation of Life Tables and Other Demographic Measures, by Giorgio Mortara (New York: United Nations, 1949), pp. 1-10. See also the articles by Giorgio Mortara in Instituto Brasileiro de Geografia e Estatística, Estudos sobre a natalidade e a mortalidade no Brasil (Rio de Janeiro: Serviço Gráfico do I.B.G.E., 1952).

³For example, see Jean Bourgeois-Pichat and Chia-Lin Pan, "Trends and Determinants of Mortality in Under-Developed Areas," in Milbank Memorial Fund, Trends and Differentials in Mortality (New York: Milbank Memorial Fund, 1956), pp. 11-25. See also United Nations, Bureau of Social Affairs, The Population of South America 1950-1980. Population Studies, No. 21, ST/SOA/Series A (New York: United Nations, 1955), p. 46 and passim.

The Present Period

The present period, which dates from approximately 1960, is characterized by the increased tempo in the number of investigations of mortality in the countries of South America. Also there is now an emphasis, slight as it may be, on determining the quality of the basic statistics.

Behm et al., in what is destined to be a classic study, analyzed the mortality trends in Chile.¹ The components of mortality were examined by age and sex. The initial declines in mortality between 1937 and 1953 were due largely to a decrease in the death rates for infective diseases. In recent years the rate of decline has slowed or there has been an actual increase for some causes of death. Improvements in medical, social, and economic areas will be necessary before further reduction in the death rate can be expected.

The analyses based on model life tables and other theoretical concepts have tended to become more cautious. Despite the mathematical rigor and the apparent high degree

¹ National Center for Health Statistics, Recent Mortality Trends in Chile. Vital and Health Statistics, Series 3, No. 2 (Washington, D.C.: Government Printing Office, 1964).

of precision obtained in the results, which sometimes deceive the unwary investigator, the experienced demographer now realizes that there is value in these methods only to the extent that a definite relationship to an actual situation can be established. Thus, in discussing one of these techniques, it is noted that " . . . when the components were obtained by statistical methods, it was necessary to relate them to various social and economic indicators in order to discover what they meant. . . . It was this second part of the work which remains to be done."¹

Similar caution is expressed by Coale, who states " . . . it is to be hoped that the need to depend on quasi-theory for estimates of current vital rates will continuously be reduced by the extension of the area covered by adequate registration, by the interim institution of accurate registration covering a carefully designed sample of the population, and by improved techniques of determining vital rates from household surveys."²

¹Jean Bourgeois-Pichat, "Application of Factor Analysis to the Study of Mortality," in Milbank Memorial Fund, Emerging Techniques in Population Research (New York: Milbank Memorial Fund, 1963), pp. 194-229.

²Ansley J. Coale, "Estimates of Various Demographic Measures Through the Quasi-Stable Age Distribution," in Milbank Memorial Fund, Emerging Techniques in Population Research (New York: Milbank Memorial Fund, 1963), pp. 175-193.

Somoza, using life tables derived from census statistics and model life tables, produced estimates of the current mortality levels in the countries of South America. Most of his conclusions, such as "The level of mortality varies greatly from one country to another," are neither new nor do the results warrant the elaborate procedures.¹

Another of the recent flood of analyses of mortality in South America is that by Gabaldon. The primary causes of death by age groups are examined. He notes a resemblance between the importance of the present causes of death in Latin America and those found in North America and northern Europe during the first three decades of the present century.²

The results of the Inter-American Investigation of Mortality are only now starting to become available. This project examines international comparability in cause-of-death diagnoses and classification. The major focus is upon adult deaths. When the results become available, they will

¹Jorge Somoza, "Trends of Mortality and Expectation of Life in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLIII, No. 4 (1965), Part 2, pp. 219-233.

²Arnoldo Gabaldon, "Leading Causes of Death in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLIII, Part 2, No. 4 (1965), pp. 242-257.

provide the means for greatly increasing our knowledge of comparative mortality of the countries of South America.¹

The increased desire to understand and improve the quality of the data during the present period is best exemplified by the work of Gaete-Darbó.² For the first time there is an analysis of the collection, or registration, aspect of vital statistics. This is the most complete survey available of vital registration in South America. He reinforces his findings by noting that, although the emphasis has been on improvement in the processing of vital statistics, their quality is more seriously affected by deficiencies and errors in the collection process.

¹Ruth R. Puffer, G. Wynne Griffithy, Dario Curiel, and Percy Stocks, "International Collaborative Research on Mortality," in World Health Organization, Trends in the Study of Morbidity and Mortality. Public Health Papers, 27 (Geneva: World Health Organization, 1965), pp. 113-130. See also Carlos Ferrero, "Health and Levels of Living in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLIII, No. 4 (1965), Part 2, pp. 281-293.

²Adolfo Gaete-Darbó, "Appraisal of Vital Statistics in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLII, No. 2 (1964), Part 2, pp. 86-103.

CHAPTER III

DEATH REGISTRATION IN SOUTH AMERICA

The registration of the death of an individual provides legal recognition of a vital event. The recording of the event may be considered as the end product that has value in providing proof of death for life insurance claims, transmission of property rights, and other situations requiring legal evidence of death. Public health, demography, and other areas can utilize these records as a source of basic information if the numbers of these individual events are compiled and tabulated.

The Concept of a Death Registration System

The concept of a death registration system functionally begins with the legal registration of the event and culminates with the distribution of mortality statistics to the potential users. Between these two ends, there is

. . . (1) statistical recording and reporting which is the procedure of transcribing

registered data for statistical purposes and of transmitting them to the statistical authorities, (2) the collection process, which brings together and controls the receipt of the statistical reports on vital events, (3) the compilation procedure which embraces the classifying and tabulating of the observations, (4) the presentation of the statistics in tabular or graphic form, and (5) the analysis of these data in terms of the problems to be studied.¹

Thus the concept of a registration system avoids the fallacy of considering the registration of the event, important as it may be, as more than an intermediate goal. It recognizes that many different agencies, with differing goals, may take part in the production of mortality statistics. Furthermore, the concept emphasizes the necessity of making the data available, in a form most suitable for the widest variety of analyses, to potential users.

The Historical Development of
Death Registration Systems

In order to evaluate properly the present development of death registration systems in South America, it is

¹United Nations, Handbook of Vital Statistics Methods. Series F, No. 7 (New York: United Nations Statistical Office, 1955), p. 7.

necessary to be aware of the historical development of these systems in other parts of the world. It is not possible or desirable to explore fully the development of every registration system, but only to note those that may be used for comparative purposes.

Early Attempts

There is evidence that the registration of deaths is not as recent a phenomenon as may be generally believed. Death registration would scarcely have been excluded from the rather elaborate registration practices that were apparently in force early in the reign of King Ramses II of Egypt; although it is doubtful that this registration of circa 1250 B.C. applied equally to all classes of the population.¹

The Romans developed an ingenious procedure for recording deaths during the reign of Servius Tullius (578-534 B.C.). It was directed that when a person died the relatives should pay a particular type of coin into the treasure of the temple of the Venus of the Grove. A count

¹Ibid., p. 213. This and the subsequent examples of early attempts to register deaths are noted in this source.

was thus kept of all deaths that had occurred. Similar procedures were used to record births and in an annual census of the population.¹

It is evident that these counts of vital events were maintained for military and fiscal purposes. These were probably also the reasons for making compulsory the registration of live births, deaths, and marriages in some parts of Japan in A.D. 720, but it is possible that there was a religious basis. Some weight is lent to this latter possibility by the knowledge that Buddhist temple registers were established in 1635.

In the church of the Middle Ages, the recording of vital events was the concern of the individual ecclesiastical authorities who had the responsibility for baptisms, burials, and weddings. The ecclesiastical registers were records of payments for the performance of a ceremony rather than the registration of the occurrence of events. In addition to the limitation of being a record of payments for ceremonies rather than a record of occurrence of events,

¹Ernest Cary, The Roman Antiquities of the Dionysius of Halicarnassus. Vol. II (Cambridge: Harvard University Press, 1939), pp. 317-319. The demographic significance of this practice was first noted in T. Lynn Smith, Fundamentals of Population Study (New York: J. B. Lippincott Company, 1960), pp. 19-20.

the ecclesiastical registers were limited in quality and coverage by being restricted to the religious rites of a specified denomination of a parish, with discretion for recording being solely in the hands of the priest in charge. There was little uniformity of the data deemed relevant among the various parishes, and the records were not designed to attest to civil or biological facts in almost any parish. The registers produced in this manner are most accurately described as ecclesiastical rolls rather than an ecclesiastical registration system.

Edge notes that systematic ecclesiastical registration began in Europe in Spain during 1497 when Cardinal Ximenes, Archbishop of Toledo, introduced registers which were to be maintained regularly by the parish priests.¹ According to him it is not improbable that Thomas Cromwell, Vicar-General under Henry VIII, had seen or heard of the Spanish registers during his continental travels in the early years of the sixteenth century and subsequently introduced them into England in 1538.² A similar ecclesiastical

¹P. Granville Edge, "Vital Registration in Europe: The Development of Official Statistics and Some Differences in Practice," Journal of the Royal Statistical Society, Vol. 91 n.s. (1928), pp. 346-379. Discussion follows on pp. 379-393.

²It is possible that an attempt to register deaths was begun in 1532. See Helen M. Walker, Studies in the

registration system was established in France in 1539 and, as a result of the Council of Trent in 1563, which promoted the registration of births and marriages, spread to other European states.

The London Bills of Mortality

Although essentially they are an example of systematic ecclesiastical registration, the London Bills of Mortality deserve special attention for three reasons.

First, they represent what could be considered a high degree of cooperation between the civil and ecclesiastical authorities. While originally administered by the clergy in each parish according to the edict of Thomas Cromwell in 1538, the maintenance of the records of all baptisms, marriages, and deaths was turned over to laymen in each parish by Parliament in 1653. Later this duty was returned to the clergy.¹ Lending additional weight to the interpretation that the Bills of Mortality represented a

History of Statistical Method (Baltimore: The Williams & Wilkins Company, 1929), p. 33.

¹Mortimer Spiegelman, Introduction to Demography (Chicago: The Society of Actuaries, 1955), p. 2.

joint civil and ecclesiastical effort is the fact that the searchers, who gathered the information about the deceased, were sworn to their office by either the Dean of Arches or by a Justice of the Peace.¹ This evidence of cooperation is part of the early recognition that it is in the interest of both the individual and the state to have a permanent, formal recording of vital events.

Second, the London Bills of Mortality represented the recognition that these vital events should be of public record, and that the tabulations of these records should be published so as to be available to all who had an interest in them. While the original purpose of the publication of the "Weekly Bills of Mortality" may have been to serve civil purposes in calming the populace faced with the threat of plague, their availability resulted in increased interest in the data.² This situation is in great contrast to the official secrecy that often surrounded the few demographic

¹D. V. Glass, "John Graunt and His Natural and Political Observations," Proceedings of the Royal Society of London, Series B (Biological Sciences), Vol. 159 (1964), pp. 2-32.

²Walker, op. cit., p. 33. See also Glass, op. cit.

statistics which may have been available in other countries.¹

The third reason for giving special consideration to the London Bills of Mortality as a landmark in the development of death registration systems is not subject to any dispute about misplaced emphasis in interpretation. Rather, it is generally acknowledged that the study of these data by John Graunt marks the beginning of mortality -- and demographic -- analyses.² Thus, as a result of Graunt's work, which supplied the evaluation and analysis of the London Bills of Mortality, there existed at that time a death registration system which met, however crudely, all of the criteria enumerated by the United Nations.

Civil Registration in England

Despite the auspicious beginnings of mortality registration as seen in Cromwell's edict and the London

¹Fernand Faure, "The Development and Progress of Statistics in France," in John Koren (ed.), The History of Statistics: Their Development and Progress in Many Countries (New York: Published for the American Statistical Association by The Macmillan Company, 1918), pp. 237-266.

²T. Lynn Smith, op. cit., p. 21. In addition to any of the general works on vital statistics, see also the "Introduction" in Walter F. Willcox (ed.), Natural and Political Observations Made upon the Bills of Mortality by John Graunt (Baltimore: The Johns Hopkins University Press, 1939), pp. iii-xiii.

Bills of Mortality, death registration in England did not become statutory until enactment of the Births and Deaths Registration Act of 1836. This act was written by Edwin Chadwick, secretary of the Poor-Law inquiry commission, possibly in consultation with John Finlaison, later first president of the Institute of Actuaries.¹ Chadwick wanted mortality statistics so that he could press effectively for a program of sanitary reform.

The appointment in 1839 of William Farr as Compiler of Abstracts in the General Register Office provided the source of energy for the continual improvement of English vital statistics. His analyses provided the foundation for sanitary reform and resulted in the recognition of the essential role that accurate vital statistics could play in the development of the nation.² This provided the impetus for the Births and Deaths Registration Act of 1874, which

¹National Office of Vital Statistics, Vital Statistics of the United States, 1950. Vol. 1 (Washington, D.C.: Government Printing Office, 1954), pp. 4-5. See also Peter R. Cox, Demography. Third edition (Cambridge, England: Published for the Institute of Actuaries by the Cambridge University Press, 1959), p. 9.

²Raymond Pearl, Introduction to Medical Biometry and Statistics. Third edition (Philadelphia: W. B. Saunders Company, 1940), pp. 30-33.

made registration compulsory and specified penalties for failure to comply. In addition, the Act of 1874 provided for a certificate of cause of death to be signed by a medical practitioner.

Civil Registration in the
United States of America

The path toward effective death registration was as difficult, if not more so, in the United States as in England. Lemeuel Shattuck, with cooperation of the Massachusetts Medical Society, finally induced the Massachusetts legislature in 1842 to enact the first state registration law. This was strengthened in 1844. Although six other states enacted registration laws by 1851, for the most part these were ineffective and unenforced.¹

It was not until the American Public Health Association was founded in 1872 that the demand for accurate vital statistics became sufficiently great to cause national action. At the suggestion of John Shaw Billings, who was placed in charge of the 1880 census of mortality, a registration area was developed in 1880. An increasing number of states and cities were included in succeeding censuses.

¹National Office of Vital Statistics, op. cit., pp. 5-7.

By 1900, the Death-Registration Area included Massachusetts, New Jersey, the District of Columbia, New Hampshire, New York, Rhode Island, Vermont, Maine, Michigan, and Indiana. However, it was not until 1933, with the admission of Texas, that all states were included in the registration area.

In contrast to England, where registration is a national function under the General Register Office, in the United States registration is a function of the individual states. The National Office of Vital Statistics (now the National Center for Health Statistics) obtains uniformity solely by advice and cooperation. However, the American Public Health Association is a strong ally in this effort.

Similarities in Development

In England and in the United States, as well as other countries that have developed effective registration systems, the successful demand for an efficient death registration system came from the strong forces promoting public health and sanitary reform. They were aided in this effort by the medical associations and the life insurance companies.

The statistics that were obtained as a result of registration were originally used only in the formulation of national and state health planning, but now they are essential

to other areas of demand for the expansion of the scope of the tabulations on the part of analysts in many fields.

Perhaps the most important similarity is that in these countries there is governmental recognition that it is in the national interest to have detailed, accurate, and complete information about deaths in their populations.

The Development of Death Registration in South America

Following the lead of the European countries, the nations of South America began to pass laws requiring compulsory death registration. Peru was the first to do this in 1852, followed by Venezuela in 1863. A number of years elapsed before Uruguay required registration, starting in 1879; Chile in 1885; followed by Brazil in 1889. Ecuador began compulsory registration in 1901 and Paraguay in 1914. However, it was not until 1938 that Colombia established compulsory civil registration, with Bolivia doing the same in 1940.¹ Death registration in Argentina is a provincial matter.

Although the laws requiring death registration were

¹United Nations, op. cit., pp. 213-216.

passed, there was usually no enforcement and little interest in promoting death registration. Statistics were compiled from the death registers, but there was no effort to determine the completeness of registration.

Administrative Organization

All countries in South America divide the responsibility for the death registration system between two or more separate governmental agencies. Usually the collection of the information, i.e., the actual registration, is the responsibility of the registro civil (civil registrar). The compilation and tabulation of mortality statistics are usually performed by a national statistical department.

The registro civil is the registrar of all legal documents, i.e., mortgages, wills, death and birth records, etc., in these countries. This reflects the concept that the death record of an individual is used for legal purposes. The many local registros civil are under the direction of the registro general at the national level. Usually the registro general is only one division of the national ministry or department of justice, which again reflects the legal nature of the registration.

The national statistical agency is responsible for

TABLE 1

ADMINISTRATIVE RESPONSIBILITY FOR THE COLLECTION AND TABULATION
OF MORTALITY STATISTICS IN THE NATIONS OF SOUTH AMERICA

Country	Original registration	Type of document	Tabulation of statistics
Argentina	Registro civil	Certificate ^b Book ^b	Central statistical office
Bolivia	Registro civil	Book Certificate	Central statistical office
Brazil	Registro civil	Book	c
Chile	Registro civil	Certificate	Central statistical office Departamento de salud publica
Colombia	Registro civil	Certificate	Central statistical office
Ecuador	Registro civil ^a	Certificate	Central statistical office
	Departamento de salud publica ^a	Certificate	Departamento de salud publica
Paraguay	Registro civil Departamento de salud publica	Book Certificate	Departamento de salud publica
Peru	Registro civil	Book Certificate	Central statistical office Departamento de salud publica
Uruguay	Registro civil	Certificate	Departamento de salud publica Central statistical office

TABLE 1.--Continued

Country	Original registration	Type of document	Tabulation of statistics
Venezuela	Registro civil	Certificate	Central statistical office Departamento de salud publica

^aRegistro civil in the rural areas; department of health in the capitals of provinces and cantons.

^bSix provinces use certificates; the remainder, books.

^cServicio de Estadística Demográfica, Moral y Política (SEDMP); Servicio Federal de Bio estadística (SFB).

Sources: Field observation, and Inter American Statistical Institute, Inventario de las Estadísticas Nacionales: Estadísticas Vitales (Washington, D.C.: Pan American Union, 1960).

the compilation and tabulation of all national statistical information. Thus, it prepares economic, educational, welfare, health, and demographic data as well as possibly meteorological information, etc. Most probably, if it is not an independent government agency, it is administratively part of a ministry or department of commerce. Thus, the compilation and tabulation of mortality statistics constitute only a small part of the total activities of the statistical office.

Expansion to Include Departments of Public Health

As part of the increasing recognition that death statistics provide the foundation for many public health programs, there is the tendency for departments of public health to become involved in the tabulation of mortality statistics. In this way they can become aware of possible health problems without undue delay.

In some cases, such as Paraguay, the local health units in certain locations may actually register the death. They then send one copy to the registro civil and another to the national health agency.

Problems in Death Registration Systems

There is no doubt that the major problem of the death registration in South America is that there is a general lack of awareness of the importance of vital statistics. In part this is caused by the undue delay in making statistical information available. Quite often programs are begun and completed before the statistics necessary for planning are available.

Problems of Registration

Gaete-Darbó has noted most of the problems in the collection field. These include lack of qualification of the local registrars, lack of training, lack of knowledge of the end product of registration, etc.¹ In addition, the part-time nature of some of the rural registrars must be considered. It is possible for a rural person to travel to a nearby Registro civil, only to find that it is not open on that particular day.

Another problem is the possibility of a fee being

¹Adolfo Gaete-Darbó, "Appraisal of Vital Statistics in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLII, No. 2 (1964), Part 2, pp. 86-103.

charged for registering a death. At present only Bolivia requires a specific fee for registration. However, since the death record is a legal document, there is the possibility that documentary tax stamps may be required. Although the fee may be small, it may be a deterrent to registration where ready cash is not always available. This is not unusual in some rural areas.

Problems of Coordination

There may be a lack of cooperation, conscious or unconscious, or actual rivalry between the two or more organizations involved in the death registration system. As the number of administrations involved in a death registration system is increased by the addition of departments of public health, this possibility becomes still greater.

In any case, the transfer of copies of documents from one organization to another increases the risk of loss or error. When deaths are recorded in books rather than on individual death certificates, it is necessary to recopy the book -- with the possibility of transcription errors.

Problems of Tabulation and Availability

Other than the usual problems of possible inadequate finances, most of the problems involved in the tabulating part of the death registration systems are minor. Training programs have increased the numbers of qualified personnel; processing procedures have been simplified; and increasing importance is being attached to the timeliness of mortality statistics.

However, the publication of mortality statistics is still sadly deficient in most of these countries. Even when the materials are published in the annual statistical volumes of these countries, there is usually a lack of sufficient cross-classification. This makes it difficult for an investigator to use these materials in anything approaching a comprehensive analysis.

General Evaluation

Of necessity any evaluation of a death registration system tends to be highly qualitative and in part subjective. However, taking into account the numerous factors mentioned here and elsewhere, it is possible to give an approximate ranking to the various countries.

The best death registration systems are found in Uruguay and Chile. However, the statistical offices in Uruguay do not publish more than a bare minimum of data. Chile ranks high because of great cooperation among administrative organizations, comprehensive publication of materials, and a high general level of support for its statistical activities. However, due to the differences in the sizes of the two countries, Chile probably has a slightly lower percentage of deaths that are recorded.

At the other end of the scale is Bolivia, where coverage is poor, cooperation is inadequate, and there is a complete lack of published materials. Peru is only slightly better than this. Ecuador presently belongs in the group having poor systems, but there the improvements are rapid. Paraguay also has a very low ranking. In it there is the possibility for some improvement, although this probably will be less rapid than that in Ecuador.

Venezuela, Colombia, and Brazil are in the middle range of the scale. All of these countries have problems of geographic coverage of deaths, although that in the cities is fairly complete. Many of the deaths taking place in the rural areas go unreported.

Argentina remains an enigma. The death registration system of the Province of La Plata is very good, but those in many of the other provinces are quite poor. In all probability, Argentina ranks somewhere in the middle of the scale.

Even the best of the death registration systems in South America can not be placed in the same category as those of most of Europe and the United States. All of them lack the basic support of a strong public health movement; and in none of them is there the strong governmental support for vital statistics that is found in the more developed countries.

CHAPTER IV

THE ACCURACY OF CAUSE-OF-DEATH STATISTICS

The uses that can be made of cause-of-death statistics are dependent upon knowledge of the accuracy of the available information. The degree of detail in an analysis of mortality, and the techniques utilized, should be considered as a function of the quality of the basic data.

This chapter examines the contributions of the three most important determinants of accuracy in cause-of-death data: (1) the qualifications of the certifier; (2) the certainty of the diagnosis; and (3) the correctness of the nosological coding procedure. Sources of inaccuracy ranging from lack of autopsies to accidental tabulating errors are of slight importance unless the inaccuracies introduced by the more important determinants are at an extremely low level. This definitely is not the case in the mortality data from the nations of South America.

The Qualifications of the Certifier

The accuracy of the certification of a cause of death is the result of the skill and training of the certifier and his knowledge of the wide range of diseases, ailments, deficiencies, accidents, and so on which can result in death. The diagnosis of a physician, who is of necessity trained in diagnostic techniques, has greater validity than that of a layman with relatively limited diagnostic knowledge. Most laymen personally are unfamiliar with any more than a dozen disease entities, while the physician must be aware of a multitude of death-causing diseases.

There is much variation in the training and diagnostic competence of physicians. Nevertheless, the greater the proportion of deaths which are medically certified, the greater the accuracy of the cause-of-death statistics.

In South America the percentage of deaths that are medically certified ranges from slightly more than one-third to a reported 100 per cent (Table 2). Data are not available for Argentina, Bolivia, and Brazil, but they probably fall within the range of the countries that have made this information available.

Actually the range in the percentage of medically

TABLE 2

PERCENTAGES OF REPORTED DEATHS THAT ARE MEDICALLY CERTIFIED
IN EACH OF THE NATIONS OF SOUTH AMERICA

	Year	Number reported	Percentage medically certified
Argentina	..	..	..
Bolivia	..	..	..
Brazil	..	..	..
Chile	1957	91,506	70.3
Colombia	1960	183,102	47.5
Ecuador	1958	60,950	35.5
Paraguay	1958	9,216	34.1
Peru	1959	114,914	44.4
Uruguay	1955	20,611	100.0 ^a
Venezuela	1960	49,927	100.0 ^b

^a"Medical certification reported to cover virtually 100 per cent of deaths except for B45, BE48 and BE50."

^bData are medically certified deaths only, comprising approximately 90 per cent of total deaths.

Source: Compiled from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961).

certified deaths is not quite as great as casual inspection of the statistics would indicate. A footnote to the published cause-of-death statistics for Venezuela comments that "Data are medically certified deaths only, comprising approximately 90 per cent of total deaths."¹ Thus, despite the initial claim of 100 per cent medical certification, in reality only approximately 90 per cent of the reported deaths are so certified. In addition, it is recognized that this claim of a rather high percentage of medically certified deaths applies only to reported deaths. Deaths which are not medically certified are more likely not to be reported than those which are so certified. Any improvement in the completeness of reporting of deaths would lower the percentage of medically certified deaths unless there are correspondingly substantial improvements in the availability of medical care.

A similar situation exists with regard to the claim by Uruguay of 100 per cent medical certification. Close examination of the qualifications of the data reveals that "Medical certification [is] reported to cover virtually 100

¹United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961).

per cent of deaths except for [categories] B45, BE48, and BE50."¹ These causes of death -- senility, ill-defined, and unknown causes (B45); accidents other than motor vehicle (BE48); and homicide (BE50) -- constitute approximately 12 per cent of the reported deaths. Thus, there is the possibility that less than 88 per cent of the deaths are medically certified if none of the deaths in these three categories received medical certification. As is the case in Venezuela and the other nations, any improvement in the completeness of registration can lower the percentage of those that are medically certified.

Great variations in the percentage of deaths that are certified by physicians are present within each of the countries. Chile may be used as an example to illustrate this variation. In the year 1957 its statisticians reported a national average of 70.3 per cent of reported deaths that were medically certified, whereas the corresponding percentage for the Province of Santiago was 94.1. Within the province, the index for the City of Santiago (which contributed over three-quarters of all deaths) stood at 98.7 per cent. At the other extreme were the Provinces of Osorno,

¹ibid.

Cautín, and Chiloé, where the comparable percentages were only 33.7, 30.8, and 25.6 per cent, respectively.¹ These intranational variations probably reflect, as do the international differences, the availability of medical attention and the degree of administrative determination to achieve medical certification of deaths.

Among the nations of South America, it is possible to distinguish three broad levels in the percentage of deaths that are medically certified. A relatively high level, in which more than two-thirds of the reported deaths are medically certified, is found in Chile, Uruguay, and Venezuela. Argentina probably also belongs in this group, although precise statistics are lacking. At the other end, the nations with only approximately one-third or less of reported deaths having medical certification are Paraguay, Ecuador, and probably Bolivia. The middle level includes Colombia, Peru, and, in all likelihood, Brazil.

Data bearing on the basic question, "To what extent does the proportion of medically certified deaths influence the resultant cause-of-death statistics?" are presented in

¹Chile, Dirección de Estadística y Censos, Demografía Año 1957 (Santiago, Chile: Dirección de Estadística y Censos, 1961).

Tables 3 through 5. These materials show the proportions of reported deaths contributed by selected broad categories of diseases by the type of certification. Chile, Colombia, and Ecuador were chosen for this analysis because each represents one of the three levels in the percentage of deaths that are medically certified, and the statistics necessary for this analysis are available.

There is considerable similarity between the relative proportions of causes, both with medical certification and without it. The similarities are greatest in the case of Chile, and least in Ecuador. Colombia occupies an intermediate position which is closer to that of Ecuador than to that of Chile. The agreement between the reported causes by the two types of certifiers would be increased if the deaths due to senility, ill-defined, and unknown causes (B45) were not taken into consideration.

The agreement in the proportions of deaths due to infective and parasitic diseases (B1-B17) found by the two types of certifiers does not hold when the individual components of the category are examined. Tuberculosis is greatly under-reported by the nonmedical certifier, while diseases such as whooping cough and measles are reported with relatively greater frequency by the nonmedical certifier.

TABLE 3

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS,
BY TYPE OF CERTIFICATION, CHILE, 1957

Cause of death	With medical certification		Without medical certification	
	Number	Per cent	Number	Per cent
Total deaths	64,303	100.0	27,203	100.0
Infective and parasitic (B1-B17)	5,357	8.3	1,733	6.4
Tuberculosis (B1-B2)	3,377	5.2	810	3.0
Whooping cough (B9)	172	0.3	296	1.1
Measles (B14)	665	1.0	321	1.2
Malaria (B16)	..	..	..	..
All other (B17)	535	0.8	112	0.4
Malignant neoplasms (B18)	5,626	8.7	1,211	4.4
Vascular lesions of the central nervous system (B22)	3,256	5.1	751	2.8
Certain diseases of the circulatory system (B24-B29)	5,356	8.3	1,215	4.5
Other diseases of the heart (B27)	548	0.8	1,057	3.9
Certain diseases of the respiratory system (B30-B32)	11,390	17.7	10,342	38.0
Influenza (B30)	2,503	3.9	2,199	8.1

Pneumonia (B31)	8,644	13.4	8,075	29.7
Bronchitis (B32)	243	0.4	68	0.2
Certain diseases of the digestive system (B33-B37)	3,819	5.9	1,002	3.7
Intestinal obstruction (B35)	445	0.7	61	0.2
Gastritis, duodenitis, enteritis, and colitis (B36)	1,842	2.9	764	2.8
Cirrhosis of the liver (B37)	1,295	2.0	83	0.3
Nephritis and nephrosis (B38)	696	1.1	30	0.1
Deliveries and complications of pregnancy, childbirth, and the puerperium (B40)	592	0.9	144	0.5
Congenital malformations (B41)	560	0.9	30	0.1
Certain diseases of early infancy (B42-B44)	10,602	16.5	4,766	17.5
Other diseases peculiar to early infancy (B44)	7,810	12.1	3,258	12.0
Senility, ill-defined, and unknown causes (B45)	4,330	6.7	3,773	13.9
All other diseases (B46)	6,111	9.5	1,646	6.0

Source: Compiled and computed from data in the Chile, Dirección de Estadística y Censos, Demografía Año 1957 (Santiago, Chile: Dirección de Estadística y Censos, 1961).

The degenerative diseases, such as malignant neoplasms, vascular lesions of the central nervous system, and diseases of the heart and other parts of the circulatory system, are relatively under-reported by nonmedical certifiers. This is also the case with certain diseases of the digestive system (B33-B37), which may in fact have infective and/or parasitic etiologies.

The major types of respiratory diseases (influenza, pneumonia, and bronchitis) are reported with relatively greater frequency by the nonmedical certifier than by the medical certifier. Part of this over-reporting is undoubtedly due to the inability to recognize tuberculosis and to a tendency to report respiratory disease as an underlying cause of, rather than as a complication in, the process of another disease. However, it may be that the excess of deaths reported in this category by nonmedical certifiers truly represents the difference in the probability of death without medical attention.

The difference in the relative reporting of deaths due to senility, ill-defined, and unknown causes (B45) is a direct reflection of the differences in the ability to recognize disease entities. With more capable certifiers many of these deaths would be assigned to the other disease

TABLE 4

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS,
BY TYPE OF CERTIFICATION, COLOMBIA, 1959

Cause of death	With medical certification		Without medical certification	
	Number	Per cent	Number	Per cent
Total deaths	84,039	100.0	92,795	100.0
Infective and parasitic (B1-B17)	9,852	11.7	9,464	10.2
Tuberculosis (B1-B2)	3,295	3.9	546	0.6
Whooping cough (B-9)	547	0.6	2,286	2.5
Measles (B14)	586	0.7	1,202	1.3
Malaria (B16)	338	0.4	970	1.0
All other (B17)	3,092	3.7	2,896	3.1
Malignant neoplasms (B18)	5,164	6.1	1,273	1.4
Vascular lesions of the central nervous system (B22)	2,584	3.1	1,108	1.2
Certain diseases of the circulatory system (B24-B29)	7,303	8.7	2,414	2.6
Other diseases of the heart (B27)	2,720	3.2	2,032	2.2
Certain diseases of the respiratory system (B30-B32)	7,516	8.9	15,403	16.6
Influenza (B30)	963	1.1	2,688	2.9

Pneumonia (B31)	4,913	5.8	5,922	6.4
Bronchitis (B32)	1,640	2.0	6,793	7.3
Certain diseases of the digestive system (B33-B37)	13,864	16.5	6,876	7.4
Intestinal obstruction (B35)	649	0.8	162	0.2
Gastritis, duodenitis, enteritis, and colitis (B36)	12,082	14.4	6,291	6.8
Cirrhosis of the liver (B37)	596	0.7	60	0.1
Nephritis and nephrosis (B38)	1,780	2.1	116	0.1
Deliveries and complications of pregnancy, childbirth, and the puerperium (B40)	692	0.8	845	0.9
Congenital malformations (B41)	1,118	1.3	80	0.1
Certain diseases of early infancy (B42-B44)	8,693	10.3	7,843	8.4
Other diseases peculiar to early infancy (B44)	4,192	5.0	1,777	1.9
Senility, ill-defined, and unknown causes (B45)	4,835	5.8	30,684	33.1
All other diseases (B46)	. . .	. . .	. . .	. . .

Source: Compiled and computed from data in the Colombia, Departamento Administrativo Nacional de Estadística, Anuario General de Estadística 1959 (Bogotá: Departamento Administrativo Nacional de Estadística, 1960).

TABLE 5

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS
BY TYPE OF CERTIFICATION, ECUADOR, 1958

Cause of death	With medical certification		Without medical certification	
	Number	Per cent	Number	Per cent
Total deaths	21,640	100.0	39,310	100.0
Infective and parasitic (B1-B17)				
Tuberculosis (B1-B2)	3,714	17.2	8,648	22.0
Whooping cough (B9)	1,051	4.8	403	1.0
Measles (B14)	318	1.5	2,703	6.9
Malaria (B16)	670	3.1	2,720	6.9
All other (B17)	155	0.7	743	1.9
	996	4.6	843	2.1
Malignant neoplasms (B18)	1,086	5.0	383	1.0
Vascular lesions of the central nervous system (B22)	395	1.8	264	0.7
Certain diseases of the circulatory system (B24-B29)	848	3.9	713	1.8
Other diseases of the heart (B27)	263	1.2	671	1.7
Certain diseases of the respiratory system (B30-B32)				
Influenza (B30)	3,244	15.0	7,771	19.8
	281	1.3	2,481	6.3

Pneumonia (B31)	1,492	6.9	1,436	3.6
Bronchitis (B32)	1,471	6.8	3,854	9.8
Certain diseases of the digestive system (B33-B37)	4,358	20.1	1,838	4.7
Intestinal obstruction (B35)	279	1.3	81	0.2
Gastritis, duodenitis, enteritis, and colitis (B36)	3,848	17.8	1,669	4.2
Cirrhosis of the liver (B37)	127	0.6	20	0.0
Nephritis and nephrosis (B38)	338	1.6	37	0.1
Deliveries and complications of pregnancy, childbirth, and the puerperium (B40)	179	0.8	376	0.1
Congenital malformations (B41)	150	0.7	29	0.1
Certain diseases of early infancy (B42-B44)	1,655	7.6	1,431	3.6
Other diseases peculiar to early infancy (B44)	905	4.2	719	1.8
Senility, ill-defined, and unknown causes (B45)	2,004	9.3	13,187	33.5
All other diseases (B46)	.	.	.	.

Source: Compiled and computed from data in the Ecuador, Dirección de Estadística y Censos, Anuario de Estadísticas Vitales 1958 (Quito, Ecuador: Dirección General de Estadística y Censos, 1960).

categories, thus giving more accurate figures of those dying from each type of disease.

It is reassuring to note that as the qualifications of the certifier decrease, the death is less likely to be attributed to a specific category of diseases. This helps to preserve the validity of the data for the broad categories of causes of death.

Even though differences in the qualifications of the certifier do result in differences in reporting of causes of death, there is sufficient agreement between the two types of certifiers that analyses may be performed, utilizing broad categories of diseases, if cautious interpretation is given to the findings. There is much less certainty in any analysis which attempts to employ the statistics for specific disease categories; and this is especially the case if the specific disease has symptoms resembling those of differently categorized diseases.

The Certainty of Diagnosis

Certainty of diagnosis of the cause of death is a relative concept. Implicit in any evaluation of the accuracy of diagnosis are the inherent limitations of the

current state of our medical knowledge and techniques. Furthermore, highly accurate diagnoses require complete clinical records, including laboratory tests, accompanied by autopsy reports. The conditions which make for a high degree of precision in diagnosis are met for only a very small minority of any population in the world.¹

In contrast to an ideal situation, medical diagnoses, and the resultant cause-of-death statistics in every part of the world, are based upon a realistic evaluation of the clinical picture available to the diagnostician. This includes as many or as few diagnostic tests as are felt to be necessary and are available. In the case of many of the infectious diseases, for an accurate diagnosis little more is needed than the rather obvious symptomology. For the degenerative diseases, as well as other diseases with obscure clinical symptoms, the accuracy of the diagnosis becomes more highly dependent upon the acumen

¹Committee on Medical Certification of Causes of Death. Statistics Section of the American Public Health Association, "Problems in the Medical Certification of Causes of Death," American Journal of Public Health, Vol. 48 (1958), pp. 71-80. This is one of the most succinct statements of the problems of medical diagnosis in relation to medical certification of death. The report includes a valuable bibliography.

of the diagnostician, with complete certainty never to be attained in every case.¹

Although it is not usually presented in these terms, the statement of the underlying cause of death for mortality certificates represents the underlying disease entity as diagnosed for purposes of treatment undertaken, or that would have been undertaken if available, in order to preserve the life of the individual.

The best indicator of the level of accuracy of diagnosis in a population is the percentage of deaths which are classified as being due to senility, ill-defined, and unknown causes (B45). Since a large part of the category, all other diseases (B46), is composed of the inexact residual categories of diseases of particular organ systems, which tend to reflect a greater level of uncertainty of diagnosis than the more specific categories, the figures for senility, ill-defined, and unknown causes (B45) are combined with all other diseases (B46) for purposes of this analysis.

¹I. M. Moriyama, W. S. Baum, W. M. Haenszel, and B. F. Mattison, "Inquiry into Diagnostic Evidence Supporting Medical Certification of Death," American Journal of Public Health, Vol. 48 (1958), pp. 1376-1387.

An examination of the statistics for the earliest and latest years for which data are available for the period through 1964 reveals three patterns of change. (See Table 6.) One type involves a substantial decrease in the proportion of deaths for which accurate diagnoses are lacking. In varying degrees, Chile, Colombia, and Uruguay typify this type of change. Paraguay might also be included in this group except for the fact that the reported figures are for an experimental area which is not representative of the entire country.

The second pattern of change is that where there has been very modest or practically no improvement in the relative number of deaths lacking accurate diagnosis. Ecuador, Peru, and Venezuela followed this pattern of minimal change. Although there is a lack of data, Bolivia also probably belongs in this group.

An increase in the proportion of deaths for which accurate diagnoses are lacking, the third pattern, is found in Brazil and Argentina. In the case of Brazil, most of the increase can be attributed to an expansion of the area for which the statistics are available to include a population which is more heterogeneous with respect to medical attention and health facilities. It is not known whether

TABLE 6

NUMBER AND PERCENTAGES OF DEATHS DUE TO SENILITY, ILL-DEFINED, AND UNKNOWN CAUSES (B45), AND ALL OTHER DISEASES (B46) IN THE NATIONS OF SOUTH AMERICA, SELECTED YEARS IN THE PERIOD 1954-1964

Country and year	Total number of deaths	Deaths due to senility, ill-defined, and unknown causes (B45), and all other diseases (B46)	
		Number	Per cent of total deaths
Argentina			
1955 (P)	167,178	50,009	29.9
1960	170,195	65,608	38.5
Bolivia			
1954	36,812	10,529	28.6
Brazil			
<u>d/</u> 1954	32,339	3,629	11.2
<u>a/</u> 1961	162,710	34,117	21.0
Chile			
1955	87,843	18,442	21.0
1964	94,058	10,009	10.6
Colombia			
<u>e/</u> 1955	161,863	52,084	32.2
1964 (P)	175,349	29,650	16.9
Ecuador			
1955	57,226	15,772	27.6
1964	58,989	14,533	24.6
Paraguay			
<u>f/</u> 1955	9,126	3,971	43.5
1962	9,311	2,562	27.5
Peru			
<u>c, g/</u> 1955	36,210	5,779	16.0
<u>b/</u> 1963	56,276	10,572	18.8
Uruguay			
1955	20,611	3,571	17.3
1961	21,954	2,394	10.9

TABLE 6.--Continued

Country and year	Total number of deaths	Deaths due to senility, ill- defined, and unknown causes (B45), and all other dis- eases (B46)	
		Number	Per cent of total deaths
Venezuela			
a/ 1955	52,294	20,366	38.9
c/ 1963	58,269	19,670	33.8

(P) Provisional or preliminary.

a/ Statistics only for the State of São Paulo and the Cities of Recife and Rio de Janeiro.

b/ Comprises only those deaths with medical certification and excludes deaths due to accident, suicide, and homicide.

c/ Excludes Indian jungle population.

d/ Statistics only for the Federal District, which is now the State of Guanabara.

e/ Data are burial permits.

f/ Data are for an area covered by 44 Health Units and 76 Health Posts, which is not representative of Paraguay.

g/ Data are medically certified deaths only.

Sources: Compiled and computed from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961); United Nations, Demographic Yearbook, 1957 (New York: United Nations Statistical Office, 1957); and Inter American Statistical Institute, América en Cifras, 1965, Situación Demográfica: Estado y Movimiento de la Población (Washington, D.C.: Pan American Union, 1966).

the increase in the relative number of deaths lacking accurate diagnoses in Argentina is due to a deterioration in the conditions promoting accurate diagnoses or is the result of a lack of comparability with the figure for the earlier year.

Although Chile, Uruguay, and Colombia showed substantial improvement during the time period, only Chile and Uruguay are approaching the level of diagnostic precision present in the nations where the mortality statistics are known to be relatively accurate. The other nations of South America still suffer in this comparison.¹

It is difficult to reconcile the claim by Venezuela of the great percentage of its deaths having medical certification with the relatively large proportion of its deaths for which adequate diagnoses are lacking. It can only be assumed that in many cases the physician is certifying to the presence of a dead body rather than having any knowledge of a clinical picture.

¹See Appendix, Table 15, for comparative statistics. The difference is even greater when it is noted that in the countries known to have accurate statistics more deaths are attributed to all other diseases (B46), which represents a higher level of diagnostic accuracy, than to senility, ill-defined, and unknown causes (B45). With the exception of Uruguay, this is the reverse of the situation found in the nations of South America.

The Correctness of Nosological
Coding Procedures

The accurate diagnosis of disease and the proper certification of death are of little advantage unless the nosologist classifies each of the disease entities so as to reflect the proper causes of death. The performance of this critical step of converting a diagnosis into a statistical entry was greatly simplified with the introduction of the Sixth Revision of the International Classification of Diseases.

With this revision there was general acceptance of the underlying cause of death as the main cause to be tabulated, and there was endorsement of the rules for selecting that cause of death as well as adoption of the lists for the tabulation of mortality data. The certifier's statement as to the underlying cause of death is ordinarily accepted. Only in exceptional circumstances, when the information is inconsistent, incomplete, or equivocal, may the nosologist resort to the special classification rules which are included in the International Classification of Diseases.¹ The Seventh Revision, which was adopted in 1955

¹World Health Organization, Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Sixth Revision (Geneva: World Health Organization, 1948-49), 2 vols.

and used in most countries by 1960, contained only minor modifications of the previous revision and helped to eliminate some of the problems of the earlier revision.¹

The publication of the manuals for the classification of diseases was the first major step in attaining comparability in the cause-of-death statistics from the nations of South America. The second major step was the establishment of the Latin American Center for the Classification of Diseases in Caracas, Venezuela. Hundreds of people from South America have received instruction there in international procedures in the collection and classification of causes of death.² Every national statistical office in South America has at least one well-trained nosologist to supervise the classification and coding procedures.

The third major step was increased communication among the vital statisticians of various countries. Evidence of this may be seen in the translation into Spanish

¹World Health Organization, Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, 1955 Revision (Geneva: World Health Organization, 1957), 2 vols.

²Ruth R. Puffer in the discussion of the paper by Adolfo Gaete-Darbó, "Appraisal of Vital Statistics in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLII, No. 2 (1964), Part 2, p. 109.

of the annual Vital Statistics Instruction Manual published by the National Center for Health Statistics of the United States Public Health Service and the periodical Nosology Guidelines published by that same agency. These publications are designed to supplement the manual of the World Health Organization.

Although national differences do exist in the certification of some diseases, and various national minor modifications of coding procedures do occur, the correctness of the nosological coding procedures is of a high order in the nations of South America. This potential source of inaccuracy has, in practice, been reduced to a minimum.

CHAPTER V

IMPORTANT CAUSES OF DEATH

Although cause-of-death statistics ostensibly provide only data about the number of persons succumbing to the various underlying causes of death, this procedure limits largely the usefulness of these materials to clinical studies and evaluations of specific programs. Furthermore, the information can be used for these purposes only when there is a relatively high degree of accuracy in the diagnoses and certification of the causes of death. Thus, an analysis of the ranking of the importance of specific causes of death in the various nations of South America would be of little value.

However, cause-of-death statistics can be used as a source of basic data for two types of analyses of health and illness in populations. First, they can provide a good index of the level of public health problems of a population. The proportion of conditions amenable to public health measures (i.e., infective and parasitic

diseases [B1-B17], certain diseases of the digestive system [B33-B37], and certain diseases of early infancy [B42-B44]) of all deaths can be used as such a yardstick. The degenerative diseases (such as malignant neoplasms [B18], vascular lesions of the central nervous system [B22], and certain diseases of the circulatory system [B24-B29]) which are not readily influenced by known public health measures may be considered as complementary to those that respond to public health programs.

A second type of analysis utilizing cause-of-death statistics is the measurement of the level of medical attention available to a population. Accurate diagnoses are essential in order for appropriate and effective therapeutic measures to be applied successfully. The level of medical resources is reflected in the adequacy of diagnoses and the utilization of therapy to prevent death from those conditions which can be controlled by modern medical techniques.

Conditions Amenable to Public Health Measures

The prevention of disease that can lead to death is the primary objective of public health programs. All of them aim to reduce mortality. Immunization, the control of

insect and animal vectors of disease, quarantine, and sanitation are basic public health techniques that have been used with great success to reduce mortality in the economically and socially developed countries throughout the world. These techniques function by breaking the chain of transmission of the disease and are effective primarily against the infective and parasitic diseases.

Although most diseases having infective or parasitic etiologies are included in the category of infective and parasitic diseases (B1-B17), there are important exclusions. The gastro-enteric diseases are included in the infective and parasitic category (B1-B17) only when the etiological organism has been specifically diagnosed and certified. Unless there has been this precise diagnosis, the death is classified to gastritis, duodenitis, enteritis, and colitis (B36). Similarly, most infections of infants would be attributed to infections of the newborn (B43) or other diseases peculiar to early infancy (B44) unless there was a diagnosis of the specific etiological organism.

In order to combine the deaths due to gastro-enteric diseases and the infections of infants with the other infective and parasitic diseases, it is necessary also to include

TABLE 7

NUMBER AND PERCENTAGES OF DEATHS DUE TO DISEASES AMENABLE TO
PUBLIC HEALTH MEASURES IN THE NATIONS OF SOUTH AMERICA,
SELECTED YEARS IN THE PERIOD 1954-1964

Country and year	Total number of deaths	Deaths due to diseases amenable to public health measures*	
		Number	Per cent of total deaths
Argentina			
1955 (P)	167,178	25,110	15.0
1960	170,195	23,462	13.8
Bolivia			
1954	36,812	14,411	31.0
Brazil			
d/ 1954	32,339	10,173	31.4
a/ 1961	162,710	48,298	29.7
Chile			
1955	87,843	25,520	29.0
1964	94,058	29,864	31.6
Colombia			
e/ 1955	161,863	50,893	31.4
1964 (P)	175,349	59,245	33.8
Ecuador			
1955	57,226	25,146	43.9
1964	58,989	21,531	39.9
Paraguay			
f/ 1955	9,129	2,311	25.3
1962	9,311	2,091	22.4
Peru			
c, g/ 1955	36,310	15,006	41.3
b/ 1963	56,276	21,416	38.0
Uruguay			
1955	20,611	2,322	11.3
1961	21,954	3,272	14.9

TABLE 7.--Continued

Country and year	Total number of deaths	Deaths due to diseases amenable to public health measures*	
		Number	Per cent of total deaths
Venezuela			
a/ 1955	52,294	15,400	29.4
c/ 1963	58,269	14,859	25.5

*Includes infective and parasitic diseases (B1-B17), certain diseases of the digestive system (B33-B37), and certain diseases of early infancy (B42-B44).

(P) Provisional or preliminary.

a/ Statistics only for the State of São Paulo and the Cities of Recife and Rio de Janeiro.

b/ Comprises only those deaths with medical certification and excludes deaths due to accident, suicide, and homicide.

c/ Excludes Indian jungle population.

d/ Statistics only for the Federal District, which is now the State of Guanabara.

e/ Data are burial permits.

f/ Data are for an area covered by 44 Health Units and 76 Health Posts, which is not representative of Paraguay.

g/ Data are medically certified deaths only.

Sources: Compiled and computed from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961); United Nations, Demographic Yearbook, 1957 (New York: United Nations Statistical Office, 1957); and Inter American Statistical Institute, América en Cifras, 1965, Situación Demográfica: Estado y Movimiento de la Población (Washington, D.C.: Pan American Union, 1966).

deaths from certain diseases which are classified similarly, but which are not of infective or parasitic origin. The error which is introduced by this procedure is comparatively small, and it becomes insignificant when consideration is given to the problem of distinguishing between these infective and noninfective conditions when the symptomology may be similar and only the results of laboratory tests can supply the correct answer.

No nation in South America has achieved the same low proportion of deaths due to diseases amenable to public health measures as may be found in most of the countries of Europe and in the United States of America and Australia. In most of these countries less than 10 per cent of the deaths are attributed to these causes. Only Argentina and Uruguay approach this level.¹ The other nations of that continent have two to four times this relative number of preventable deaths.

¹See Appendix, Table 15, for comparative statistics. Differences between the Sixth and Seventh Revisions of the International Classification of Diseases are ignored, since only insignificant changes would result in any but the detailed categories. See Mattie M. Faust and Alice B. Dolman, "Comparability of Mortality Statistics for the Sixth and Seventh Revisions: United States, 1958," Vital Statistics -- Special Reports, Vol. 51, No. 4 (1965).

Diseases Which Reflect the Level
of Available Medical Care

When adequate measures for the prevention of infective and parasitic diseases are lacking, it does not necessarily follow that deaths from these causes will be numerous. Modern medicine has a large arsenal of weapons for the cure of infective and parasitic diseases. These range from direct antibiotic therapy to general supportive therapy and symptomatic treatment of the illness. However, where reliance is placed upon the medical treatment of illness rather than the prevention of disease, the level of mortality from infective and parasitic diseases will be slightly higher. This is because some ill persons will die despite adequate therapy, when they would not have even become ill had there been effective prevention.

The level of medical care is inversely related to the proportion of deaths occurring with lack of precise diagnoses of the illnesses as well as deaths from causes where effective therapy is known to exist. Statistics for deaths amenable to public health measures; deaths that are inaccurately diagnosed or certified and are classified to senility, ill-defined, and unknown causes (B45) and all other causes (B46); and deaths due to certain diseases

of the respiratory system (B30-B32) are combined and presented in Table 8. The diseases of the respiratory system are included because even when there may not be a specific antibiotic therapy available for a particular disease, a high level of general supportive and symptomatic therapy will markedly reduce mortality from these diseases.

Only Uruguay compares favorably with the countries of the world known to have high levels of medical care. In the other nations of South America, deaths due to diseases which reflect a low level of available medical care number 50 to 75 per cent of the total deaths. In comparison, these causes account for approximately 25 per cent of all causes of death in the United States of America, Denmark, England and Wales, and Australia.

The degenerative diseases, malignant neoplasms (B18), vascular lesions of the central nervous system (B22), and certain diseases of the circulatory system (B24-B29), are causes of death for which modern medicine lacks cures and can only delay the time of death. Despite their association with the aging process of humans, these diseases can be important causes of death even in the younger ages, when mortality from other causes of death is reduced to compara-

TABLE 8

NUMBER AND PERCENTAGES OF DEATHS DUE TO DISEASES WHICH
REFLECT THE LEVEL OF AVAILABLE MEDICAL CARE IN THE
NATIONS OF SOUTH AMERICA, SELECTED YEARS IN THE
PERIOD 1954-1964

Country and year	Total number of deaths	Deaths due to diseases which reflect the level of <u>available medical care</u>	
		Number	Per cent of total deaths
Argentina			
1955 (P)	167,178	83,339	49.8
1960	170,195	97,131	57.1
Bolivia			
1954	36,812	25,242	68.6
Brazil			
d/ 1954	32,339	16,500	51.0
a/ 1961	162,710	94,398	58.0
Chile			
1955	87,843	61,498	70.0
1964	94,058	55,579	59.1
Colombia			
e/ 1955	161,863	121,476	75.0
1964 (P)	175,349	110,601	63.1
Ecuador			
1955	57,226	50,104	87.6
1964	58,989	46,364	78.6
Paraguay			
f/ 1955	9,129	7,038	77.1
1962	9,311	5,336	57.3
Peru			
c,d/ 1955	36,310	26,123	71.9
b/ 1963	56,276	45,731	81.3
Uruguay			
1955	20,611	6,922	33.6
1961	21,954	6,254	29.7

TABLE 8.--Continued

Country and year	Total number of deaths	Deaths due to diseases which reflect the level of <u>available medical care</u>	
		Number	Per cent of total deaths
Venezuela			
g/ 1955	52,294	38,953	74.5
c/ 1963	58,269	38,015	65.2

*Includes infective and parasitic diseases (B1-B17); certain diseases of the respiratory system (B30-B32); certain diseases of the digestive system (B33-B37); certain diseases of early infancy (B42-B44); senility, ill-defined, and unknown causes (B45); and all other diseases (B46).

(P) Provisional or preliminary.

a/ Statistics only for the State of São Paulo and the Cities of Recife and Rio de Janeiro.

b/ Comprises only those deaths with medical certification and excludes deaths due to accident, suicide, and homicide.

c/ Excludes Indian jungle population.

d/ Statistics only for the Federal District, which is now the State of Guanabara.

e/ Data are burial permits.

f/ Data are for an area covered by 44 Health Units and 76 Health Posts, which is not representative of Paraguay.

g/ Data are medically certified deaths only.

Sources: Compiled and computed from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961); United Nations, Demographic Yearbook, 1957 (New York: United Nations Statistical Office, 1957); and Inter American Statistical Institute, América en Cifras, 1965, Situación Demográfica: Estado y Movimiento de la Población (Washington, D.C.: Pan American Union, 1966).

tively low levels.¹ In this sense they are complementary to the diseases which reflect the level of medical care.

In all of South America only in Uruguay does the proportion of deaths due to degenerative diseases compare to those found in countries known to have high levels of medical care. In these countries over 50 to almost 70 per cent of all deaths are attributed to these diseases. Less than one-third of all deaths are so classified in the other nations of South America.

Trends in Causes of Death

Improvements in the percentages of deaths due to causes amenable to public health measures have not been great. In some countries, such as Argentina and Peru, the apparent modest improvement was the result of changes in classification, since the percentage of deaths due to causes which reflect the lack of medical care increased.

There is absolutely no indication that there was any rapid change in the relative importance of causes of

¹National Center for Health Statistics, The Change in Mortality Trend in the United States. N.C.H.S. Series 3, No. 1 (Washington, D.C.: U.S. Public Health Service, 1964).

TABLE 9

NUMBER AND PERCENTAGES OF DEATHS DUE TO DEGENERATIVE DISEASES
IN THE NATIONS OF SOUTH AMERICA, SELECTED YEARS
IN THE PERIOD 1954-1964

Country and year	Total number of deaths	Deaths due to degenerative diseases*	
		Number	Per cent of total deaths
Argentina			
1955(P)	167,178	65,677	39.3
1960	170,195	53,472	31.4
Bolivia			
1954	36,812	1,678	4.6
Brazil			
<u>d/</u> 1954			
<u>a/</u> 1961	162,710	50,030	30.7
Chile			
1955	87,843	17,074	19.4
1964	94,058	23,137	24.6
Colombia			
<u>e/</u> 1955	161,863	18,418	11.4
1964 (P)	175,349	26,461	15.1
Ecuador			
1955	57,226	3,147	5.5
1964	58,989	4,124	7.0
Paraguay			
<u>f/</u> 1955	9,126	1,140	12.5
1962	9,311	1,455	15.6
Peru			
<u>c, d/</u> 1955	36,210	5,690	15.7
<u>b/</u> 1963	56,276	7,115	12.6
Uruguay			
1955	20,611	10,064	48.8
1961	21,954	11,657	53.1

TABLE 9.--Continued

Country and year	Total number of deaths	Deaths due to degenerative diseases*	
		Number	Per cent of total deaths
Venezuela			
a/ 1955	52,294	8,091	15.5
c/ 1963	58,269	12,182	20.9

*Includes malignant neoplasms (B18), vascular lesions of the central nervous system (B22), and certain diseases of the circulatory system (B24-B29).

(P) Provisional or preliminary.

a/ Statistics only for the State of São Paulo and the Cities of Recife and Rio de Janeiro.

b/ Comprises only those deaths with medical certification and excludes deaths due to accident, suicide, and homicide.

c/ Excludes Indian jungle population.

d/ Statistics only for the Federal District, which is now the State of Guanabara.

e/ Data are burial permits.

f/ Data are for an area covered by 44 Health Units and 76 Health Posts, which is not representative of Paraguay.

g/ Data are medically certified deaths only.

Sources: Compiled and computed from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961); United Nations, Demographic Yearbook, 1957 (New York: United Nations Statistical Office, 1957); and Inter American Statistical Institute, América en Cifras, 1965, Situación Demográfica: Estado y Movimiento de la Población (Washington, D.C.: Pan American Union, 1966).

death during the period 1954-1964. However, the greatest improvement, small as it may have been, was found in those countries which had the largest percentages of total deaths attributed to those causes which reflect the level of available medical care.

A detailed examination of the tables in this chapter leaves no doubt that the causes of death amenable to public health measures, and those reflecting the lack of medical care, have been and are presently the most important sources of mortality in all the nations of South America, with the possible exception of Uruguay. Unless there is a more rapid change in the health conditions of South America in the future than there was between 1954 and 1964, it will be many years before the degenerative diseases assume the importance there that they have in other parts of the world.

CHAPTER VI

RURAL-URBAN DIFFERENTIALS IN CAUSE OF DEATH

The observation that the rural death rates are lower than the urban was originally made by John Graunt in 1662. Since that time repeated observations of this phenomenon in many parts of the world have resulted in the statement that this differential " . . . probably is still true in most parts of the world."¹ Improvements in environmental sanitation in urban areas and the great concentration of medical care resources in the cities may be changing this differential.²

The reported improvements in environmental sanitation, control of communicable diseases, maternal and child

¹T. Lynn Smith, Fundamentals of Population Study (New York: J. B. Lippincott Company, 1960), p. 22. See also T. Lynn Smith, Brazil: People and Institutions, revised edition (Baton Rouge, La.: Louisiana State University Press, 1963), pp. 110-111.

²United Nations, Department of Economic and Social Affairs, Population Bulletin of the United Nations, No. 6 - 1962 (New York: United Nations, 1963), p. 16.

health services, and availability of medical resources in the nations of South America have tended to be concentrated in the urban areas to a greater degree than in the rural areas.¹ This has given rise to the conjecture that reported declines in mortality in these countries since 1945 have been primarily the result of these improvements in urban areas. However, measures of rural-urban differentials are generally lacking in South America.²

Definitions of Rural and Urban

The published mortality statistics for the countries of South America do not separate deaths in rural areas from those in urban districts. Therefore, the technique used in this analysis is to take the deaths in the provinces containing the largest cities in the nation and compare them to the deaths in the rest of the country. Chile, Colombia, and Ecuador, representing the three levels in percentage of deaths that were certified by physicians, were chosen for this analysis.

The provinces of Valparaíso, Santiago, and Concepción

¹Milton I. Roemer, Medical Care in Latin America. Pan American Union Studies and Monographs, III (Washington, D.C.: Pan American Union, 1963), passim.

²United Nations, Department of Economic and Social Affairs, op. cit., p. 31.

represent the most urban populations in Chile. These contain the Cities of Valparaíso and Viña del Mar, Santiago, and Concepción, respectively. In Colombia the most urban populations are in the Departments of Antioquia, Atlántico, Cundinamarca, and Valle del Cauca, which contain the Cities of Medellín, Barranquilla, Bogotá, and Cali, respectively. The Provinces of Guayas and Pichincha were considered to be the most urban in Ecuador, since these contain the Cities of Guayaquil and Quito, respectively.

Differentials in Cause of Death

Deaths from causes amenable to public health measures are relatively equally represented in the most urban provinces and the rest of the country in Chile.¹ Deaths from these causes comprise 29.0 per cent of all mortality in the urban provinces and 30.4 per cent of that in the rest of the country. This is in contrast to Colombia, where the deaths from these causes constitute 34.3 per cent of the total in the most urban departments and 30.3 per cent in the

¹This includes infective and parasitic diseases (B1-B17), certain diseases of the digestive system (B33-B37), and certain diseases of early infancy (B42-B44).

TABLE 10

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS IN THE PROVINCES OF VALPARAÍSO, SANTIAGO, AND CONCEPCIÓN, AND IN THE REST OF CHILE, 1957

Cause of death	Provinces of Valparaíso, Santiago, and Concepción		The rest of Chile	
	Number	Per cent	Number	Per cent
Total deaths	39,171	100.0	52,335	100.0
Infective and parasitic (B1-B17)	2,797	7.1	4,293	8.2
Malignant neoplasms (B18)	3,646	9.3	3,191	6.1
Vascular lesions of the central nervous system (B22)	2,298	5.9	1,709	3.3
Certain diseases of the circulatory system (B24-B29)	3,374	8.6	3,197	6.1
Certain diseases of the respiratory system (B30-B32)	7,698	19.6	14,034	26.8
Certain diseases of the digestive system (B33-B37)	2,186	5.6	2,635	5.0
Certain diseases of early infancy (B42-B44)	6,370	16.3	8,998	17.2
Senility, ill-defined, and unknown causes (B45)	2,644	6.7	5,459	10.4

Source: Compiled and computed from data in the Chile, Dirección de Estadística y Censos, Demografía Año 1957 (Santiago, Chile: Dirección de Estadística y Censos, 1961).

TABLE 11

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS IN THE DEPARTMENTS OF ANTIOQUIA, ATLÁNTICO, CUNDINAMARCA, AND VALLE DEL CAUCA, AND IN THE REST OF COLOMBIA, 1959

Cause of death	Departamentos of Antioquia,Atlántico, Cundinamarca, and <u>Calle del Cauca</u>		The rest of Colombia	
	Number	Per cent	Number	Per cent
Total deaths	75,532	100.0	101,302	100.0
Infective and parasitic (B1-B17)	7,465	9.9	11,851	11.7
Malignant neoplasms (B18)	3,837	5.1	2,600	2.6
Vascular lesions of the central nervous system (B22)	2,072	2.7	1,620	1.6
Certain diseases of the circulatory system (B24-B29)	5,613	7.4	4,104	4.0
Certain diseases of the respiratory system (B30-B32)	8,199	10.8	14,720	14.5
Certain diseases of the digestive system (B33-B37)	10,685	14.1	10,055	9.9
Certain diseases of early infancy (B42-B44)	7,757	10.3	8,779	8.7
Senility, ill-defined, and unknown causes (B45)	9,150	12.1	26,369	26.0

Source: Compiled and computed from data in the Colombia, Departamento Administrativo Nacional de Estadística, Anuario General de Estadística 1959 (Bogotá, Colombia: Departamento Administrativo Nacional de Estadística, 1960).

TABLE 12

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS IN THE PROVINCES OF GUAYAS AND PICHINCHA, AND IN THE REST OF ECUADOR, 1958

Cause of death	Provinces of Guayas and Pichincha		The rest of Ecuador	
	Number	Per cent	Number	Per cent
Total deaths	17,378	100.0	43,572	100.0
Infective and parasitic (B1-B17)	3,321	19.1	9,041	20.7
Malignant neoplasms (B18)	704	4.0	765	1.8
Vascular lesions of the central nervous system (B22)	264	1.5	395	0.9
Certain diseases of the circulatory system (B24-B29)	726	4.2	835	1.9
Certain diseases of the respiratory system (B30-B32)	2,902	16.7	8,113	18.6
Certain diseases of the digestive system (B33-B37)	2,751	15.8	3,445	7.9
Certain diseases of early infancy (B42-B44)	1,285	7.4	1,801	4.1
Senility, ill-defined, and unknown causes (B45)	2,430	14.0	12,761	29.3

Source: Compiled and computed from data in the Ecuador, Dirección General de Estadística y Censos, Anuario de Estadísticas Vitales 1958 (Quito, Ecuador: Dirección General de Estadística y Censos, 1960).

remainder of the country. This contrast is even greater in Ecuador, where 42.3 per cent of the deaths in the most urban provinces are from these causes, compared to 32.8 per cent in the more rural portions of the country.

However, this picture changes radically when the group of diseases reflecting the level of medical care is used in the analysis.¹ The percentage of deaths due to these causes is smaller in the most urbanized provinces than in the rest of the country: 55.4 per cent in the urban provinces of Chile compared to 67.7 per cent in the remainder of the country. In Colombia and Ecuador, comparable percentages are 57.3 and 70.8 and 73.0 and 80.7, respectively.

Differences in diagnostic and certification accuracy may have influenced the observed differentials. It is known that a larger percentage of the deaths in urban areas are certified by physicians than in rural. Only in the published data for Ecuador is it possible to control for differences in adequacy of diagnosis in order to determine if the observed rural-urban differentials are genuine.

¹This includes infective and parasitic diseases (B1-B17); certain diseases of the respiratory system (B30-B32); certain diseases of the digestive system (B33-B37); certain diseases of early infancy (B42-B44); and senility, ill-defined, and unknown causes (B45).

Examination of the statistics for the urbanized provinces compared to the rest of the country reveals that, when only medically certified deaths are considered, there is no significant difference between the two areas. The percentage of deaths due to causes reflecting the level of medical attention is 69.7 in the most urban provinces and 68.7 in the remainder of the country.

It is not known if the findings for Ecuador can be generalized to all the other nations of South America. However, the situation is probably the same in other countries reporting a large proportion of their total deaths as due to causes which reflect the level of medical attention.

TABLE 13

PERCENTAGES SELECTED CAUSES OF DEATH WITH MEDICAL CERTIFICATION ARE OF ALL MEDICALLY CERTIFIED DEATHS IN THE PROVINCES OF GUAYAS AND PICHINCHA AND IN THE REST OF ECUADOR, 1958

Cause of death	Provinces of Guayas and Pichincha		The rest of Ecuador	
	Number	Per cent	Number	Per cent
Total deaths	10,622	100.0	11,018	100.0
Infective and parasitic (B1-B17)	1,695	16.0	2,019	18.3
Malignant neoplasms (B18)	614	5.8	472	4.3
Vascular lesions of the central nervous system (B22)	213	2.0	182	1.6
Certain diseases of the circulatory system (B24-B29)	485	4.6	363	3.3
Certain diseases of the respiratory system (B30-B32)	1,682	15.8	1,562	14.2
Certain diseases of the digestive system (B33-B37)	2,268	21.4	2,090	19.0
Certain diseases of early infancy (B42-B44)	998	9.4	657	6.0
Senility, ill-defined, and unknown causes (B45)	760	7.2	1,244	11.3

Source: Compiled and computed from data in the Ecuador, Dirección General de Estadística y Censos, Anuario de Estadísticas Vitales 1958 (Quito, Ecuador: Dirección General de Estadística y Censos, 1960).

CHAPTER VII

LEVELS OF MORTALITY

The level of mortality of a population represents the sum total of the strengths of the many forces of mortality times the susceptibility of the population. The forces of mortality are the many causes of death that are present in a given area. The susceptibility represents the individuals' physical reactions upon coming into contact with the causes of death.

Methods of Decreasing the Level of Mortality

Decreases in the levels of mortality may be accomplished either through reduction in the forces of mortality, a reduction in the susceptibility to the diseases, or a combination of these factors.¹

¹It was decided not to burden the reader with the multitude of specific sources for each of these general statements about the influence upon levels of mortality. Instead, reference should be made to Louis I. Dublin, Alfred

Rabies and tetanus as well as other causes of death, including the degenerative diseases, are very strong forces of mortality. Death is the usual result of contracting these diseases. At the other extreme, chicken pox, mumps, and the common cold may be considered as diseases that normally have little force of mortality. High levels of mortality from causes that are of moderate or low strength signify that the susceptibility of the population to these diseases is high.

The susceptibility of individuals is influenced by age, degree of immunity, general physical well-being, and supportive measures that are available to prevent or alleviate the development of complications during the disease process. The promotion of immunity through vaccination results in a lowering of susceptibility. High general physical well-being allows the body's natural defenses to function at maximum efficiency, thereby reducing susceptibility. Therapeutic measures check the course of a disease until the body's defense mechanisms can rally to overcome the disease.

J. Lotka, and Mortimer Spiegelman, Length of Life. Revised edition (New York: Ronald Press, 1949), passim. The reader requiring more detail can find detailed explanations in the citations contained in this source.

Reducing the Forces of Mortality

Prevention of contact with a disease is the simplest method for reducing the force of mortality. This can be accomplished by elimination in an area of the etiological factors or by breaking the chain of transmission of the causative agents.

The elimination of the etiological factors has been the procedure used throughout the modern world to reduce the force of the former scourges of mankind such as plague, cholera, and smallpox. This same procedure is used in some countries, such as the United States, to prevent yellow fever and malaria. In the case of the elimination of the etiological agents, the vectors for the transmission of the disease are still present, but the etiological agents are absent.

The breaking of the chain of transmission of a disease has been the procedure used in the control of such diseases as malaria, yellow fever, typhus, typhoid fever, and the gastro-enteric infections. The reduction or elimination of the insect vectors of malaria, yellow fever, and typhus has occurred in many parts of the world. The purification of water and raising of the sanitary level of

foods result in the substantial reduction of typhoid fever and the gastro-enteric infections as well as other diseases.

Quite often the breaking of the chain of transmission is the first step in the elimination of a disease. In this way the number of new cases of a disease is constantly reduced until the etiological agent is no longer present among the population. However, total elimination of a disease is not possible if there are intermediate hosts which can provide reservoirs of infection.

Decreasing the Susceptibility of a Population

Increasing the level of immunity to diseases is the simplest way of reducing the mortality from these sources. When morbidity from a disease is not present, mortality cannot result from it. Immunity from many diseases can be given through the use of vaccines. Diphtheria, whooping cough, smallpox, and typhoid fever are among those diseases for which vaccines are available, and to which susceptibility can be decreased. Most of the vaccines that are presently available confer immunity upon an individual for only a limited time. Thus, the immunity must be periodically renewed. Unfortunately there are many diseases of infective

and parasitic origin for which vaccines have not yet been developed.

General physical well-being, in terms of adequate nutrition, prevention of exposure to adverse extremes of the weather, and so on, has an important, although not yet fully understood, role in reducing susceptibility to disease. Susceptibility to tuberculosis is apparently greatly influenced by this factor. High levels of general physical well-being tend to reduce the onset of complicatory diseases in a person who is already suffering from another disease.

The susceptibility to death is decreased by the availability of supportive therapy. This includes chemotherapy, antibiotic therapy, and general supportive therapy designed to maintain the functions of the body during the course of a disease. The uses of chemotherapy and antibiotic therapy are too well known to require description here. It will suffice to say that accurate determination of the infecting organism is necessary in order for these to be effectively utilized. Measures to prevent excess loss of fluids during the diarrheal diseases, and oxygen therapy during the respiratory diseases, are also examples of general supportive therapy.

Age as a Mediating Factor

The age distribution of a population is an independent variable influencing the forces of mortality and the level of susceptibility to death. Some diseases have greater force in the older ages than they do in the younger. The reverse is true in the case of other diseases.

The degenerative diseases have their greatest force in the case of older persons. The susceptibility to these diseases is also greatest in the later years of life. This does not mean that the degenerative disease cannot be present with fatal results in younger persons. Rather, these diseases are sufficiently uncommon in these years so that they can account for large proportions of the deaths in these ages only when the other causes of death are substantially reduced.

The infective and parasitic diseases exact their greatest toll during the periods of infancy and childhood. Apparently the susceptibility is high during these years because the body has not yet acquired the natural immunities as a result of being previously exposed to the agents of these diseases. Also, the general level of well-being is

low in that the body is not yet fully developed. However, the infective and parasitic diseases can still exact a frightening toll among older persons, when the level of susceptibility is high. Tuberculosis can be an important cause of death among the elderly. Yellow fever, typhoid fever, malaria, and others are certainly not respecters of the age of an individual.

While almost any disease can cause death at any age, the ages of greatest mortality are the young ages, primarily from infective and parasitic diseases, and the older ages, primarily from degenerative diseases.

The Reported Rates of Mortality in South America

Although the crude death rate is a comparatively inaccurate measure, since it does not take into account differences in the age and sex composition of the population, it is virtually the only index that is available for the various countries of South America. The statistics necessary to compute standardized death rates are either unavailable or open to too much question about their accuracy.

The nations of South America have, in recent years,

reported crude death rates ranging from slightly above 8 per thousand population in Argentina, Bolivia, Uruguay, and Venezuela to more than 14 per thousand population in Ecuador. Brazil has yet not reported deaths for the total country.

Until fairly recently a crude death of less than 10 per thousand was almost automatically suspect of having been heavily influenced by under-registration of deaths. Since then, further reductions in the already low mortality of certain countries, combined with a favorable age composition of the population, have resulted in rates of less than 10 that are known to be accurate.

The population experts of the United Nations have apparently accepted the possibility that the substantial reductions that have taken place since 1900 in the mortality levels of the South American countries can result in death rates of less than 10 in some of these.¹ They accept the fact that the mortality rate of less than 10 per thousand is reasonably accurate for Argentina, Uruguay, and Venezuela. The reported rate for Chile, which is approximately 12 per

¹United Nations, Department of Economic and Social Affairs, Population Bulletin of the United Nations, No. 6 - 1962 (New York: United Nations, 1963), pp. 32-33 and passim.

thousand population, is also considered accurate. Estimates which range from 12 to 25 per thousand population are presented for the other countries.

Acceptance or rejection of the reported rates is based upon how closely these conform to the values derived from model life tables. The rates that are estimated are also based on these model life tables.

The Consistency between Mortality Levels and Causes of Death

The model life tables possess great mathematical preciseness. Also, they apparently are accurate representations of mortality in countries known to have comparatively complete reporting of deaths. These same countries are the ones that have reduced mortality to very low levels. The validity of the use of these tables for nations having higher rates of mortality is still open to question.

One test of the validity of the values derived from the model life tables is a comparison of the causes of death between countries known to have low mortality and those where the life tables estimate low mortality.

It has been shown in Chapter IV that, when broad

categories of causes of death are used, the resulting statistics can be used for comparative purposes. It has been shown in Chapter V that all the South American countries have large proportions of their deaths still due to causes that are amenable to public health measures and those which reflect a low level of medical care. In the case of Uruguay, the proportion is only slightly above those found in countries known to have low mortality. At the other extreme, Ecuador and Peru are shown to have three and almost four times this proportion of their deaths due to these causes.

Since it is the reduction in deaths from these causes that results in the low mortality rates found in other parts of the world, it is not possible to accept the low estimated rates for the nations of South America that are based on model life tables. Nor is it possible to accept the reported rates that are judged to be accurate when compared to the model life table values.

Before completely discarding the published mortality figures, it is necessary to give some attention to the possible influences of differing age compositions of the populations. The countries that are known to have low mortality

also have greater proportions of their populations in the younger ages than do the countries of South America. This means that the heavy toll of deaths exacted by the degenerative diseases is not present in most of the South American nations. This could result in very low crude death rates if the number of deaths due to preventable causes is at a low level.

Since the South American nations still have not reduced their deaths from the diseases that reflect the level of medical care to the levels found in the other countries of low mortality, this should result in a high crude death rate. This is caused by the high mortality from these causes acting upon the large percentages of their populations that are in the very young ages. The proposition that the comparatively large percentages of the populations in the very young ages results in the large proportions of deaths from diseases amenable to public health measures is untenable. The proportion of deaths from these causes is far higher than that which results merely from the presence of large percentages of young children. The only valid conclusion is that the death rates in these countries are higher than either the reported rates or the published estimates.

The Author's Estimates of Mortality Levels

Although this writer hesitates to add to the already far too many estimates of the mortality levels of the countries of South America, Table 14 presents his estimates of the rates, based upon the comparisons presented in this investigation. These are admittedly very crude, and they certainly are not the result of such rigorous mathematical procedures as are the rates derived from model life tables. However, they are the results of the only available study comparing cause-of-death statistics and mortality levels.

The factors that were taken into account in the preparation of the estimates include the forces of mortality and the susceptibility of the population as seen in the reported causes of death and the age composition of the respective populations. This writer's personal knowledge of certification and cause-of-death reporting practices and the observations made during the field work constitute, of necessity, aspects of the subject that were used in arriving at these estimates.

Constant comparisons were made between past and present mortality levels in other countries that now have low mortality rates. These aided in determining the starting

TABLE 14

RECENT REPORTED AND ESTIMATED CRUDE DEATH RATES
IN THE NATIONS OF SOUTH AMERICA

Country	Recent reported rate	United Nations' estimate	Author's estimate
Argentina	8.1 (1960)	8.4 (1955-57)	14-16
Bolivia	8.5 (1960)	18-25 (1953-57)	28-32
Brazil	. .	16-19 (1953-57)	20-25
Chile	11.9 (1960)	12.5 (1955-57)	14-16
Colombia	12.0 (1961)	15-17 (1953-57)	20-25
Ecuador	14.3 (1959)	15-17 (1953-57)	25-30
Paraguay	10.6 (1955-59)	12-18 (1953-57)	22-26
Peru	11.3 (1960)	15-22 (1953-57)	22-26
Uruguay	8.1 (1960)	7.4 (1955-58)	10-12
Venezuela	8.0 (1960)	9.9 (1955-58)	16-18

Sources: Compiled from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961); and United Nations, Department of Economic and Social Affairs, Population Bulletin of the United Nations, No. 6 - 1962 (New York: United Nations, 1963), pp. 32-33.

and end points of the scale of estimates presented here.

Problems Raised by These Estimates

Many of the questions that arise from the presentation of these new estimates can be answered by a brief consideration of the mortality trends in South America from approximately 1900 to the present. Many major causes of death have either been eliminated or reduced greatly. Yellow fever, malaria, and smallpox are examples of these. There must have been a substantial reduction in the levels of mortality when these diseases were overcome. Thus, objections to these estimates are that they do not allow for the great reductions in mortality that have taken place.

These objections are valid only if the reported level of mortality at the start of this period is too low. Although the study of mortality trends is outside the scope of this study, there is no reason to believe that the general levels of mortality around 1900 were any lower than those few high rates that are found in the statistics compiled by Hoffman.¹ If it is assumed that the quality of

¹Frederick L. Hoffman, Mortality of the Western Hemisphere. Panama-Pacific Exposition Memorial Publications of the Prudential Insurance Company of America, No. 3 (Newark, N.J.: Prudential Press, 1915), passim.

death registration has not decreased, in these countries, then death rates of approximately fifty per thousand, or even slightly above this, probably represent the general level of mortality to be found at the earlier time. Thus, the substantial reductions in mortality are not in conflict with the author's estimates if the proper starting base is used.

These estimates are in conflict with the data that are now available demonstrating the rapid growth of the populations of these countries. More accurately, the estimates are in conflict with the rates of reproduction that are derived from the equation that the rate of population growth equals the birth rate minus the death rate.

Although discussion of this problem is also beyond the scope of this study, it may be that even those measures of reproduction such as the fertility ratio

$$\left(\frac{\text{number of children under 5}}{\text{number of women 15-49}} \times 100 \right)$$

underestimate the true level of reproduction when infant and childhood mortality is very high. The demonstration of the validity of this hypothesis will have to await further investigation.

CHAPTER VIII

SUMMARY

With a few notable exceptions, the study of mortality data from the nations of South America is just now beginning. This has been due to the lack of available statistics and to a tendency to rely upon information derived from hypothetical models, even when the validity of these has not yet been demonstrated.

This appraisal of the mortality data from the nations of South America contains a brief examination of the quality of death registration systems in South America. Although none of these now are on the same level as those found in the countries that are more advanced socially and economically, there is considerable variation in quality from country to country. Under-registration of deaths is the major deficiency of all the registration systems. It is least in Uruguay and Chile and greatest in Bolivia, Ecuador, Paraguay, and Peru. The fact that responsibility for the registration of deaths is divided among two or more

administrative agencies is a major factor preventing improvements in the percentages of deaths that are registered. This factor also contributes to delays in the compilation and tabulation of the materials and is a potential source of errors.

Great improvements have been made in the procedures used in the compilation and tabulation of mortality data, and there also has been progress in the training of the personnel. However, the comparative lack of publication of the statistics, and the lack of cross-tabulations in the published materials are factors which still prevent comprehensive analyses of the data.

The percentage of deaths certified by physicians varies from approximately 90 in Uruguay and Venezuela to only 35 in Ecuador and Paraguay. There also is variation within countries, with the percentages of medically certified deaths in the large cities being greater than those in the rural areas and small urban centers. In some countries, such as Venezuela, it is obvious that in many cases the physician is certifying to the presence of the corpse rather than to an accurate diagnosis of the cause of death. The relative proportions of the causes of death reported

by medical and nonmedical certifiers are in reasonable agreement. However, a larger percentage of the deaths without medical certification are attributed to ill-defined or unknown causes than is the case of those certified by physicians.

If broad categories of diseases are employed, the cause-of-death statistics are sufficiently reliable so as to facilitate comparisons among the nations of South America and those in other parts of the world. Nevertheless, it is not possible to compare specific categories of diseases with even a modest degree of certainty that the figures are accurate for individual causes of death.

Due to the relatively great lack of precise diagnoses, it is not valid to rank individual causes of death in order of importance. However, when deaths from causes that reflect the level of medical care are considered, the proportions of deaths due to these is two to three times greater than those found in countries known to have low mortality levels. The exception is Uruguay, which has only slightly more deaths due to these causes than is reported for the nations of the world with low death rates.

When medical certification is held constant, no

significant rural-urban differentials are found in the proportions of causes of death in Ecuador. This can only be interpreted to mean that in this country (one with a high level of mortality), the public health measures and medical care have reduced urban deaths from preventable causes to the same level as that normally enjoyed by rural areas. It is anticipated, although it has not been demonstrated, that in countries where the death rate is fairly low, most of the improvement has been in the urban areas.

When a comparison is made among the causes of death in the countries of South America and those in nations known to have low rates of mortality, it is not possible to accept the reported or estimated rates for the American countries. In all cases they are too low, and for a few countries they are as much as 50 per cent less than the author estimates to be the actual case. Only in Uruguay does the crude death rate approximate that of countries enjoying low mortality rates.

While there have been substantial reductions in the death rates of the countries of South America since 1900, these have been due to the control or elimination of the former scourges of mankind such as yellow fever, malaria,

and smallpox. Reductions in deaths from causes that are controlled primarily by an individual observance of sanitary measures have been limited in most of these countries.

If the author's estimates of the mortality levels in these countries are valid, then even the most liberal estimates of reproduction rates in South America are too low. There may be need for revision in current thinking about the upper limits of the indexes of reproduction.

Although data for comprehensive studies of mortality are still lacking for most countries in South America, there are sufficient materials available for analyses of the kinds that will provide further checks of the internal consistency and validity of the reported statistics.

APPENDIX

TABLE 15

PERCENTAGES SELECTED CAUSES OF DEATH ARE OF ALL REPORTED DEATHS IN SELECTED NATIONS
KNOWN TO HAVE MORTALITY STATISTICS OF HIGH QUALITY

Cause of death	United States		England		Israel		Australia	
	of America	Denmark	France	and Wales	(1960)	(1959)	(1960)	(1960)
	(1959)	(1959)	(1960)	(1959)				
Total deaths	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic (B1-B17)	1.4	0.9	2.6	1.2	1.9	1.1	1.1	1.1
Malignant neoplasms (B18)	15.7	22.8	17.3	18.4	18.6	15.0	15.0	15.0
Vascular lesions of the central nervous system (B22)	11.6	12.5	12.0	14.2	10.8	13.4	13.4	13.4
Certain diseases of the circulatory system (B24-B29)	39.5	30.6	19.2	33.2	29.6	37.2	37.2	37.2
Certain diseases of the respiratory system (B30-B32)	3.6	4.6	5.9	12.0	3.0	5.2	5.2	5.2

Certain diseases of the
digestive system
(B33-B37)

2.9 2.9 3.9 2.2 3.7 2.5

Certain diseases of early
infancy (B42-B44)

4.1 2.3 1.9 1.8 5.8 3.0

Senility, ill-defined, and
unknown causes (B45)

1.2 1.5 14.6 1.5 3.3 1.0

All other diseases (B46)

8.1 9.8 11.7 7.6 9.6 8.9

Source: Compiled and computed from data in the United Nations, Demographic Yearbook, 1961 (New York: United Nations Statistical Office, 1961).

REFERENCES

- Argentina: Summary of Biostatistics. Washington, D.C., processed, 1945.
- Bourgeois-Pichat, Jean. "Application of Factor Analysis to the Study of Mortality," in Milbank Memorial Fund, Emerging Techniques in Population Research. New York: Milbank Memorial Fund, 1963, pp. 194-229.
- Bourgeois-Pichat, Jean, and Pan, Chia-Lin. "Trends and Determinants of Mortality in Under-Developed Areas," in Milbank Memorial Fund, Trends and Differentials in Mortality. New York: Milbank Memorial Fund, 1956, pp. 11-25.
- Cary, Ernest. The Roman Antiquities of the Dionysius of Halicarnassus. Vol. II. Cambridge: Harvard University Press, 1939.
- Chandrasekhar, S. Infant Mortality in India, 1901-55. London: George Allen and Unwin, Ltd., 1959.
- Chile, Dirección de Estadística y Censos. Demografía Año 1957. Santiago, Chile: Dirección de Estadística y Censos, 1961.
- Coale, Ansley J. "Estimates of Various Demographic Measures Through the Quasi-Stable Age Distribution," in Milbank Memorial Fund, Emerging Techniques in Population Research. New York: Milbank Memorial Fund, 1963, pp. 175-193.
- Colombia, Departamento Administrativo Nacional de Estadística. Anuario General de Estadística 1959. Bogotá, Colombia: Departamento Administrativo Nacional de Estadística, 1960.

- Committee on Medical Certification of Causes of Death.
Statistics Section of the American Public Health
Association. "Problems in the Medical Certifica-
tion of Causes of Death," American Journal of
Public Health, Vol. 48 (1958), pp. 71-80.
- Cox, Peter R. Demography. Third edition. Cambridge,
England: Published for the Institute of Actuaries
by the Cambridge University Press, 1959.
- Dublin, Louis I.; Lotka, Alfred J.; and Spiegelman, Mortimer.
Length of Life. Revised edition. New York: Ronald
Press, 1949.
- Dunn, Halbert L.; Eldridge, Hope Tisdale; and Powell, Nora
P. "Demographic Status of South America," Vital
Statistics -- Special Reports, Vol. 23 (1944), pp.
63-78.
- Ecuador, Dirección General de Estadística y Censos.
Anuario de Estadísticas Vitales 1958. Quito:
Ecuador: Dirección General de Estadística y Censos,
1960.
- Edge, Granville. "Vital Registration in Europe: The
Development of Official Statistics and Some Dif-
ferences in Practice," Journal of the Royal
Statistical Society, Vol. 21 n.s. (1928), pp. 346-
393.
- Estudos sobre a natalidade e a mortalidade no Brasil. Rio
de Janeiro: Serviço Gráfico do I.B.G.E., 1952.
- Faure, Fernand. "The Development and Progress of Statistics
in France," in John Koren (ed.), The History of
Statistics: Their Development and Progress in Many
Countries. New York: Published for the American
Statistical Association by The Macmillan Company,
1918.
- Faust, Mattie M., and Dolman, Alice B. "Comparability of
Mortality Statistics for the Sixth and Seventh
Revisions: United States, 1958," Vital Statistics --
Special Reports, Vol. 51, No. 4 (1965).

- Ferrero, Carlos. "Health and Levels of Living in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLIII, No. 4 (1965), Part 2, pp. 281-293.
- Gabaldon, Arnoldo. "Leading Causes of Death in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLIII, No. 4 (1965), Part 2, pp. 242-257.
- Gaete-Darbó, Adolfo. "Appraisal of Vital Statistics in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLII, No. 2 (1964), Part 2, pp. 86-103.
- Glass, D. V. "John Graunt and His Natural and Political Observations," Proceedings of the Royal Society of London, Series B (Biological Sciences), Vol. 159 (1964), pp. 2-32.
- Graham, Saxon. "Sociological Aspects of Health and Illness," in Robert E. L. Faris (ed.), Handbook of Modern Sociology. Chicago: Rand McNally & Company, 1964, pp. 310-347.
- Hoffman, Frederick L. Mortality of the Western Hemisphere. Panama-Pacific Exposition Memorial Publications of the Prudential Insurance Company of America, No. 3. Newark, N.J.: Prudential Press, 1915.
- Instituto Brasileiro de Geografia e Estatística. Estudos sobre a natalidade e a mortalidade no Brasil. Rio de Janeiro: Serviço Gráfico do I.B.G.E., 1952.
- Inter American Statistical Institute. America en Cifras, 1965, Situación Demográfica: Estado y Movimiento de la Población. Washington, D.C.: Pan American Union, 1966.
- Inter American Statistical Institute. Inventario de las Estadísticas Nacionales: Estadísticas Vitales. Washington, D.C.: Pan American Union, 1960.
- Inter American Statistical Institute. Statistical Activities of the American Nations: 1940. Washington, D.C.: Inter American Statistical Institute, 1941.

Linder, Forrest E. "Population and Population Statistics of the Caribbean Area," Vital Statistics -- Special Reports, Vol. 12 (1941), pp. 559-571.

Logan, W. P. D. "The Measurement of Infant Mortality," Population Bulletin of the United Nations, No. 3 (1953), pp. 30-55.

Moriyama, I. M.; Baum, S. W.; Haenszel, W. M.; and Mattison, B. F. "Inquiry into Diagnostic Evidence Supporting Medical Certification of Death," American Journal of Public Health, Vol. 48 (1958), pp. 1376-1387.

National Center for Health Statistics. The Change in Mortality Trend in the United States. N.C.H.S. Series 3, No. 1. Washington, D.C.: U.S. Public Health Service, 1964.

National Center for Health Statistics. Recent Mortality Trends in Chile. Vital and Health Statistics, Series 3, No. 2. Washington, D.C.: Government Printing Office, 1964.

National Office of Vital Statistics. Vital Statistics of the United States, 1950. Vol. 1. Washington, D.C.: Government Printing Office, 1954.

Pan American Health Organization. Task Force on Health at the Ministerial Level, Washington, D.C. 15-20 April 1963. Official Document No. 51. Washington, D.C.: Pan American Health Organization, 1964.

Pan American Union. Tercera Conferencia Interamericana de Estadística, Petrópolis, Brazil, 9 al 23 de junio de 1955, Acta Final. Washington, D.C.: Pan American Union, 1956.

Pearl, Raymond. Introduction to Medical Biometry and Statistics. Third edition. Philadelphia: W. B. Saunders Company, 1940.

Puffer, Ruth R.; Griffity, G. Wynne; Curiel, Dario; and Stocks, Percy. "International Collaborative Research on Mortality," in World Health Organization, Trends in the Study of Morbidity and Mortality.

- Public Health Papers, 27. Geneva: World Health Organization, 1965, pp. 113-130.
- Roemer, Milton I. Medical Care in Latin America. Pan American Union Studies and Monographs, III. Washington, D.C.: Pan American Union, 1963.
- Saunders, J. V. D. The People of Ecuador: A Demographic Analysis. Latin American Monographs No. 14. Gainesville, Fla.: University of Florida Press, 1961.
- Smith, T. Lynn. Brazil: People and Institutions. Baton Rouge, La.: Louisiana State University Press, 1946, revised edition, 1963.
- Smith, T. Lynn. "Current Population Trends in Latin America," American Journal of Sociology, Vol. 62 (1956/57), pp. 399-406.
- Smith, T. Lynn. Fundamentals of Population Study. New York: J. B. Lippincott Company, 1960.
- Smith, T. Lynn. Latin American Population Studies. University of Florida Monographs, Social Sciences, No. 8. Gainesville, Fla.: University of Florida Press, 1960.
- Smith, T. Lynn. "The Reproduction Rate in Latin America," Population Studies, Vol. 12 (1958/59), pp. 4-17.
- Somoza, Jorge. "Trends of Mortality and Expectation of Life in Latin America," The Milbank Memorial Fund Quarterly, Vol. XLIII, No. 4 (1965), Part 2, pp. 219-233.
- Spiegelman, Mortimer. Introduction to Demography. Chicago: The Society of Actuaries, 1955.
- Stolnitz, George F. "A Century of International Mortality Trends: I," Population Studies, Vol. IX (1955/56), pp. 24-25.

- U.S. Bureau of the Census. General Censuses and Vital Statistics in the Americas. Prepared under the supervision of Irene B. Taeuber. Washington, D.C.: Government Printing Office, 1943.
- U.S. National Office of Vital Statistics. Summary of International Vital Statistics: 1937-1944. Washington, D.C.: Government Printing Office, 1947.
- United Nations. Demographic Yearbook, 1957. New York: United Nations Statistical Office, 1957.
- United Nations. Demographic Yearbook, 1961. New York: United Nations Statistical Office, 1961.
- United Nations. Handbook of Vital Statistics Methods. Series F, No. 7. New York: United Nations Statistical Office, 1955.
- United Nations, Bureau of Social Affairs. The Population of South America 1950-1980. Population Studies, No. 21, ST/SOA/Series A. New York: United Nations, 1955.
- United Nations, Department of Economic and Social Affairs. Methods of Appraisal of Quality of Basic Data for Population Estimates. Population Studies No. 23. New York: United Nations, 1955.
- United Nations, Department of Economic and Social Affairs. Population Bulletin of the United Nations, No. 6 - 1962. New York: United Nations, 1963.
- United Nations, Department of Social Affairs. Methods of Using Census Statistics for the Calculation of Life Tables and Other Demographic Measures, by Giorgio Mortara. New York: United Nations, 1949.
- Walker, Helen M. Studies in the History of Statistical Method. Baltimore: The Williams & Wilkins Company, 1929.
- Whipple, George C. Vital Statistics. New York: John Wiley & Sons, Inc., 1923.

Willcox, Walter F. (ed.). Natural and Political Observations Made upon the Bills of Mortality by John Graunt. Baltimore: The Johns Hopkins University Press, 1939.

World Health Organization. Annual Epidemiological and Vital Statistics. Geneva: World Health Organization.

World Health Organization. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Sixth Revision. Geneva: World Health Organization, 1948-49, 2 vols.

World Health Organization. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, 1955 Revision. Geneva: World Health Organization, 1957, 2 vols.

World Health Organization. World Health Statistics Annual. Geneva: World Health Organization.

BIOGRAPHICAL SKETCH

Leonard L. Linden was born in New York, New York, January 8, 1931. In 1948 he was graduated from high school in Miami, Florida. The University of Florida conferred the degree of Bachelor of Arts upon him in 1957 and the degree of Master of Arts in 1959.

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This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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